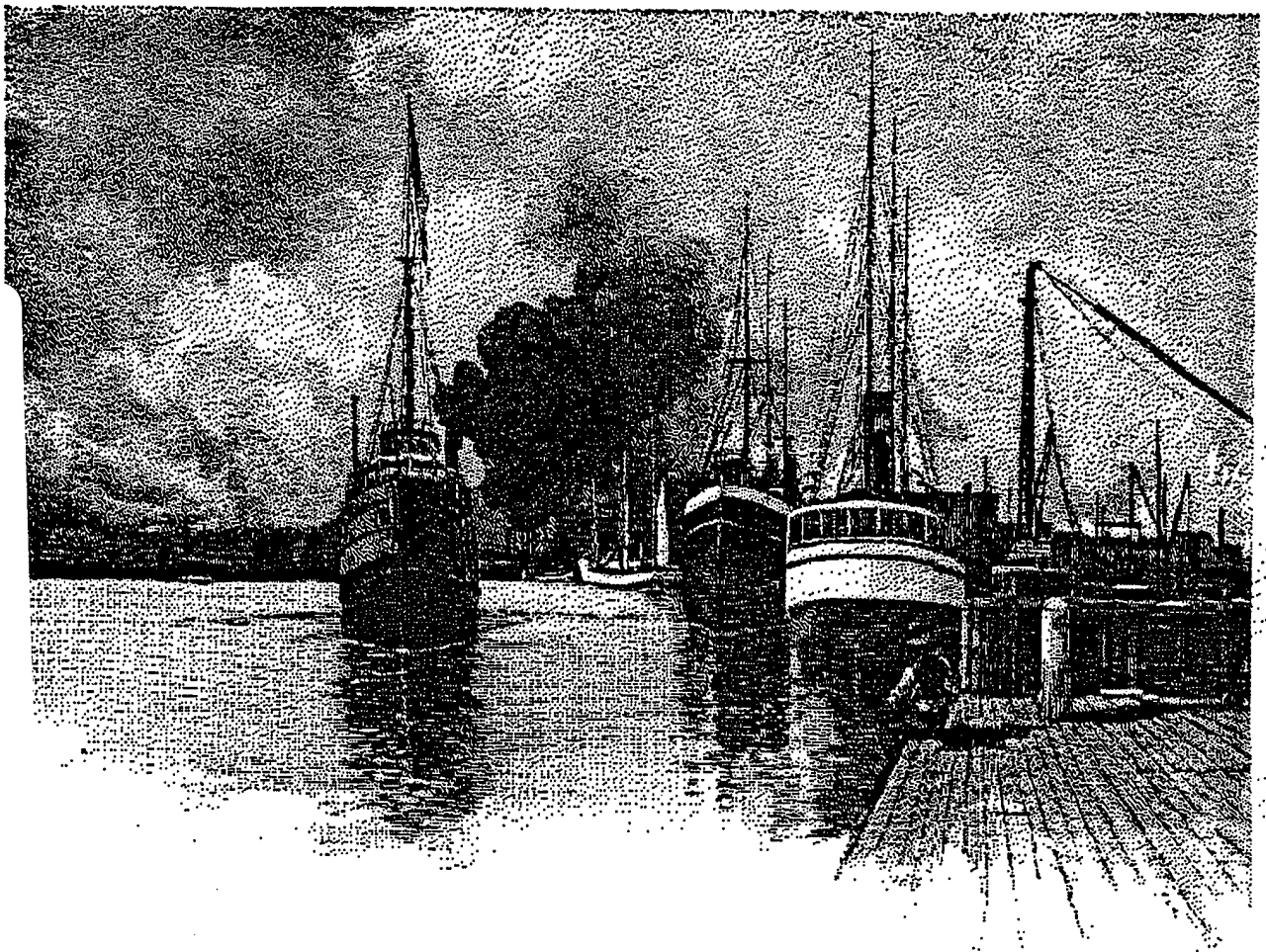


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# GULF COAST REGION MARITIME TECHNOLOGY CENTER

## Quarterly Report 96 - GCRMTC - QR03

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*July 1, 1996 - September 30, 1996*

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**GULF COAST REGION MARITIME  
TECHNOLOGY CENTER**

**QUARTERLY REPORT**

**96-GCRMTC-QR03**

**Cooperative Agreement N00014-94-2-0011**

**REPORT PERIOD: Jul 1, 1996 - Sep 30, 1996**

**SUBMITTED TO: Mr. Dale Rome  
Director  
Shipbuilding Technology Office  
Carderock Division  
Naval Surface Warfare Center**

**SUBMITTED BY:  
Gulf Coast Region Maritime Technology Center  
New Orleans, LA**

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## EXECUTIVE SUMMARY

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994 and has been designated as a Navy Center of Excellence in Advanced Marine Technology.

The Center issued a second solicitation for Concept Proposals in August 1995 from the marine industry and from university researchers. Based on peer reviews, Government/Industry Advisory Board (GIAB) recommendations and Government Program Manager (GPM) approval, three requests for proposals were issued in late April 1996. The proposals submitted in response to our three RFP's were peer reviewed, ranked, and will be submitted to the GPM for approval for funding. A third solicitation for Concept Proposals (both internal and external) was issued in January 1996 and a fourth solicitation (internal only) was issued in July 1996.

The GCRMTC initiated the Environmental Resources and Information Center (ERIC) and the Simulation-based Design Center (SBDC) in 1995. ERIC, which is collocated at the New Orleans Site is a depository and resource for environmental issues of concern to the shipbuilding/marine industries. ERIC is fully operational, and its operations and services are fully detailed on the World Wide Web. The SBDC is collocated at the Orange Site and is fully operational. Its operations and services are also fully detailed on the World Wide Web (WWW).

The GCRMTC will issue, in the very near future, agreements funding seven National Shipbuilding Research Program (NSRP) projects at a total cost of \$1.7 million, based on commitments made to the Executive Control Board of the NSRP and the NSRP Panels by the Orange Site some time ago. These projects are as follows:

1. Two Interactive Training Modules
2. Application of Industrial Engineering Technologies
3. Develop Leapfrog Technology to Standardize Equipment
4. Implementation and Update of Design for Production Manual
5. Assist U. S. Shipyards to develop/maintain Skilled Trades Workers and Structured Job Training
6. Vendor Furnished Information Guidelines
7. Activity Analysis for a World Class Design Model

Status reports on 14 collaborative research projects being conducted are appended for reference. These projects are in collaboration with shipbuilding/marine industry partners.

The Center plans to set up an exhibit at the Shipbuilding Machinery and Marine Technology Exhibition and Conference (SMM '96) in Hamburg, Germany in October.



The Center, New Orleans Site and Orange Site staff expended considerable effort inputting data into the MANTECH Database, a tool designed to assist in program management of Navy Centers of Excellence.



# **GCRMTC QUARTERLY REPORT**

**July 1 - September 30, 1996**

## **1. INTRODUCTION**

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994 and is now fully operational. As part of the Center's mission, research is carried out at both its New Orleans Site and its Orange Site. The Center has been designated as a Navy Research Center of Excellence in Advanced Marine Technology.

The Center also solicits concept ideas for collaborative research from maritime industries and then issues Requests for Proposals (RFPs) under the guidance and direction of its Government/Industry Advisory Board (GIAB) and the Government Program Manager (GPM). All research projects sponsored by the Center at both its Sites are collaborative research projects with marine industry partners.

## **2. CONCEPT PROPOSAL SOLICITATION**

In August, 1995, the Center sent out a second solicitation for Concept Proposals to over 375 industry and academic sources. Approximately 50 responses were received and processed through an external peer review process. The results of the peer reviews along with Center recommendations were presented to the GIAB on December 7, 1995. The external Concept Proposals approved by the GIAB were submitted to the GPM, along with rankings and recommendations for consideration for issuance as Requests for Proposals (RFPs). In late April 1996, three RFPs were issued, and four proposals were subsequently received and peer reviewed. Recommendations will be transmitted to the GPM in the next quarter for his decision regarding funding.

In January 1996, another solicitation for Concept Proposals (both internal and external) was sent to over 300 addressees. These Concept Proposals were peer reviewed and the results were presented to the Government/Industry Advisory Board (GIAB) in May, 1996. The GIAB recommendations were submitted to the GPM and issuance of RFPs is awaiting completion of project abstracts and final GPM review.

In July 1996, a solicitation for internal concept proposals was issued. Peer review and evaluation of the proposals has commenced.



A master schedule (Appendix A) depicts time frames for both the RFP and Concept Proposal Solicitations and other events pertaining to the Center and its New Orleans and Orange Sites.

### **3. 1996 MARINE INDUSTRY PROPOSALS**

Based on the December 1995 recommendations of the GIAB regarding Concept Proposals, the Center formulated requests for proposals (RFPs), and obtained the approval of the GPM to issue RFPs in the following three areas:

1. A Case Study of Dimensional Analysis Effects on Structural and Outfit Design Production.
2. Second Generation Data Collection Module Development and Rollout for the Ship Operations Cooperative Program's (SOCPs) Reliability, Availability, Maintainability (RAM) Database.
3. Design, Fabrication and Testing of Fire-Tolerant Composite Structures for Commercial and Navy Uses.

Four proposals submitted in response to the RFPs were peer reviewed. The proposals along with Center recommendations and rankings will be submitted to the GPM for approval. As stated in Section 2, additional RFPs will be issued based on the May 1996 GIAB meeting.

### **4. SHIPBUILDING MACHINERY & MARINE TECHNOLOGY EXHIBITION AND CONFERENCE (SMM '96)**

The Center has made plans to participate in the SMM '96 in Hamburg, Germany as part of the U. S. Pavilion. The GCRMTC was active in the American International Shipbuilding Exposition held in April 1996 in New Orleans. The SMM '96 is another opportunity to publicize the GCRMTC and to establish a dialogue with the operators, contractors, and suppliers of the world's ships.

### **5. MANTECH Database Input**

During the month of July, several days of effort (136 hours) from several staff members was required to input data in to the MANTECH Database. The Database information on all current research projects including objectives, benefits, contacts and total financial information.

The purpose of the Database, as stated in the requirements letter, is to create a tool to aid in Navy program management of the various Navy Centers of Excellence.



## **6. GCRMTC CENTERS**

The GCRMTC has initiated three sub-Centers — Shipbuilding Environmental Resource Center, Simulation-Based Design Center, and a Marketing Resource Center. The Simulation-based Design and Environmental Resource Information Centers are fully established. The Marketing Resource Center is in the formative stage at present.

### **6.1 Environmental Resource Information Center (ERIC)**

ERIC was established to address the environmental issues of the shipbuilding industry. It assists with matters pertaining to the planning and implementation of environmental and health related methodologies by providing ready access to available sources of information and with its resident expertise. ERIC facilitates the collection and distribution of technical and regulatory information within the industry.

#### **6.1.1 ERIC's On-Going and Rapid Response Activities**

##### **Document Maintenance and Collection**

ERIC maintains hard copies of all NSRP reports dealing with environmental issues, and copies of SP-1 Panel progress reports, and most memoranda, hand-outs and other material distributed by mail or at meetings. Also, ERIC maintains current federal and state regulatory information through the Bureau of National Affairs, Inc. "Environmental Reporter" and electronic files. This information is used to prepare the SP-1 Panel Newsletter and can be copied for distribution to members. The SP-1 Panel Newsletter and the ERIC Newsletter are both available from ERIC through its WWW.

A compilation of technical documents describing market based instruments for pollution control has been initiated. Several documents published on this topic by the Organization for Economic Cooperation and Development (OECD), and by other institutions were reviewed. Of special interest is the possibility of using these instruments as an alternative to Administrator Browner's Common Sense Initiative for the shipbuilding industry. Additional publications from OECD, the World Bank, the Intra-American Development Bank, and the EPA will be purchased for ERIC's library, and will also be reviewed.

The UNO collection of information on Pollution Prevention technologies continues to grow. Also, ERIC's staff can conduct and will assist others with their literature searches involving Pollution Prevention databases.



## **NSRP SP-1 and SP-3 Liaison**

ERIC's personnel actively participate in NSRP's SP-1 and SP-3 Panel activities. The first SP-1 Panel Newsletter produced by ERIC was well received by the SP-1 membership. The second newsletter has been completed and will be mailed out before the next SP-1 Panel meeting. A number of the proposed sub-tasks under the Environmental Studies and Testing Project have been reviewed in an effort to identify tasks of mutual interest. ERIC has committed to developing one of these projects involving a report to the panel on the available environmental sources on the internet. The next SP-1 and SP-3 meeting will take place in Portland, Maine in October. ERIC will be sending four of its staff to participate at the meeting.

### **Upcoming NSRP SP-1 and SP-3 Meeting in New Orleans**

ERIC and Avondale Shipyards will host the SP-1 and SP-3 meeting in New Orleans during the week of February 3-7, 1996 before Mardi Gras. The meetings will be held at UNO's Downtown Center. Rooms have been blocked for the meeting participants at the Hampton Inn Hotel within the UNO Center. Part of the program will include a tour of ERIC's and the Gulf Coast Region Maritime Technology Center's facilities, and other engineering and environmental laboratories.

## **EPA's Environmental Leadership Program**

ERIC's personnel also participated in an EPA effort to develop a framework for the total program that is to be distributed to states and facilities around the country to facilitate the development of more effective Pollution Prevention programs. ERIC's efforts are directed at determining the impact of these types of programs on the shipbuilding and repair industry. This program is being coordinated through the Louisiana State Department of Environmental Quality's program at the University of New Orleans.

## **ERIC Toxic Release Inventory Hazard Value Model**

A PC program based on the University of Tennessee's Center for Clean Products and Clean Technologies chemical rating and scoring method developed for the EPA was reported as being available from ERIC in the previous quarter. The ERIC program calculates a "TOTAL HAZARD VALUE (THV)" for TRI chemicals to better assess the potential human health and environmental impacts of a facility's emissions. The program can also be used to calculate the THV of individual or groups of compounds, and the THV of all compounds released by a facility or industry.

Since ERIC's initial offer of this program, it has been upgraded based on user responses. The new version 1.1 was released in September. The latest version of the ERIC Model can now be accessed through Internet at <http://www.uno.edu/~engr/eric.html>. Copies of the program disk are also available.



## **6.1.2 Educational Programs**

### **Workshops**

The content and presentations for two workshops dealing with ISO 14000 and the EPA's Common Sense Initiative (CSI) and Project XL were developed during this quarter. These topics focus on the potential impact of these initiatives on the shipbuilding and repair industry. While CSI and Project XL focus on approaches that will provide "Cleaner, Cheaper and Smarter" regulatory systems, ISO 14000 is an international program designed to establish an effective environmental management system that can be integrated with other management requirements, to assist organizations to achieve environmental and economic goals.

Fliers and mail-outs were prepared and sent out on the ISO 14000 Workshop which was to be offered in September 1996. Unfortunately, the response at this time was insufficient to warrant holding the workshop. The subject is timely and should be of interest. It is being reviewed and will probably be offered during the next quarter. Two to three workshops are planned for the next quarter.

## **6.1.3 Visibility, Communications and Industry Participation**

Mailing lists from various sources have been integrated into a national list of shipbuilding and repair facilities in the United States. Facilities in the southeastern region of the United States were contacted by telephone to confirm addresses, contacts, telephone and FAX numbers. A similar survey will be conducted on other regions with high concentrations of shipbuilding and repair facilities. The mailing list will be used to distribute ERIC and SP-1 Panel Newsletters. The latter was distributed to the NSRP mailing list obtained from NASSCO. The SP-1 Newsletter has increased the number of requests for names to be added to the mailing lists.

### **ERIC's WWW Page**

The ERIC WWW page has been expanded to include the ERIC and SP-1 Panel Newsletters, a functional version of the ERIC TRI-HVM, and current regulatory highlights of importance to the shipbuilding and repair industry. Abstracts of GCRMTC environmental project reports are being included as the reports become available. The SP-1 Panel Newsletter contains status reports of current projects as well as a list of proposed projects.

New features added to the ERIC web page includes an "ask ERIC" option, where visitors can pose questions and receive answers and/or guidance for further information. "The Web Page," an article written by ERIC for the SP-1 Newsletter and covering environmental information on the internet is available. A counter which will keep track of the number of visits to the home page has also been included. The ERIC WWW page is accessible through Internet at <http://www.uno.edu/~engr/eric.html>.



## **ERIC's "Fax-Back" System**

ERIC has installed a "fax-back" system to deliver documents to users that do not have internet access. Users will be able to request documents to be faxed back to their location using an activated phone attendant. Document loading will begin in the fourth quarter.

### **6.1.4 ERIC's NSRP SP-1 Activities**

#### **SP-1 Newsletter**

The Newsletter is an important step in Panel SP-1's strategic plan to improve its visibility and communication with other National Shipbuilding Research Program (NSRP) Panels, Executive Control Board (ECB), U.S. shipyards and other interested groups. ERIC has produced the second newsletter and will be mailing it out in early October.

Several new articles or features have been added to the most recent newsletter. These include an article by the SP-1 Program Manager and a feature article entitled "The Web Page." The Newsletter is published several times a year by ERIC, and contains information on SP-1 Panel Projects, regulatory issues, and interim reports on selected projects and other pertinent topics.

#### **WWW Environmental Resources**

There has been interest within SP-1 membership to document and assist those who would like to know what environmental resources may be available on the internet. Funding has not been available to establish this as a fully supported activity for SP-1. ERIC has accepted, and is implementing, with the approval of the SP-1 Panel, a program which will address this issue. It initially includes the development of a on-going featured column in the SP-1 Newsletter. The objective is to help less-experienced computer users locate useful environmental information on the WWW; in particular, pollution prevention information that is relevant to ship design, construction, and operation. Ultimately, the information developed in preparing these articles will produce a guide document which will be published in the future as a report. The first of the article series has been completed and is in the Fall 1996 NSRP SP-1 Newsletter.

### **6.1.5 Work Plan and Activities Planned for Next Quarter**

ERIC plans to implement the following activities during the next quarter:

- Maintenance and collection of selected reports and documents from NSRP, EPA and other.

- Development of systems for making ERIC information available to the ship building industry



Close participation and support of NSRP SP-1 and SP-3 Panel activities and seek opportunities for mutual projects.

Attend and participate in SP-1 Panel meetings during the October Portland, Maine meeting.

Presentation of two or more workshops and development of other topics environmental issues of interest to the industry.

Publish several technical bulletins, *ERIC Reports*, on selected projects of interest.

Maintenance and development of the ERIC's Website.

## **6.2 Simulation Based Design (SBD) Center**

### **6.2.1 Regional**

#### **Application of SBD to Mobile Offshore Base System (MOBS) Project**

This project is underway. The first phase of the scope of work has been completed with visualization modeling demonstrations provided to McDermott during the third week of September. The major portions of the Center's work responsibilities are scheduled for the January 1997 through April 1997 period. Additional researchers from the University of New Orleans (UNO) have been identified to support the project activities.

The MOBS project has received considerable national recognition as an option to land-based installations. The Center's efforts and contributions are significant to the acquisition potential of this platform.

#### ***SBD as an Environment for Concept and Contract Design Using IPPD***

The Orange Site participated in development of this proposal during the previous quarter with Avondale serving as the lead organization. The other participants besides Avondale Industries and the GCRMTC are Intergraph Corporation, General Dynamics Electric Boat Corporation, and the Institute for Competitive Design.

Kick-off occurred the week of July 15, 1996 with Orange personnel and UNO personnel attending two days of IPPD training and three days related to defining scope of work for the project. The project has been revised and updated based on this and subsequent meetings.

The project is underway. The Center retained the services of a naval architecture and marine engineering graduate and assigned this individual responsibilities associated with this project. Avondale has notified the Center that its contract with Maritech (via MARAD) has not been



approved to date and that the Center should continue to undertake its activities. It is anticipated that a subcontract and/or purchase order will be issued shortly.

### ***Development of an Integrated Product and Process Data Environment to Revolutionize Shipbuilding Processes***

The Orange Site was included in this project proposal as a technology demonstration site. Other members of the team are Hughes Aircraft, Advanced Marine Enterprises, Orincon Corporation, Intelligent Systems Technology, American Bureau of Shipping, and Mr. Lou Chirillo. This project is being led by Hughes Aircraft, Avondale, Intergraph, and Bath Iron Works.

Hughes has completed its negotiations with Maritech regarding the scope of work. Orange Site personnel have been working closely with Hughes which is a newcomer to the marine industry. The specific role and scope of work for the Orange site has yet to be negotiated.

The initiation of the project was scheduled, originally, in June; however, this has been delayed. Project updates and status reports are available via Internet. The Orange Site's role in this project is still to be defined beyond its general inclusion. Follow on meetings between the Orange Site and Hughes will be scheduled. During the first full week in July a meeting took place among the consortium members. The actual project kickoff meeting for the full project team was conducted on July 15 & 16.

Subsequent to the initial kick-off meeting, Center personnel visited Hughes to review the Center's role and responsibilities within the project. These continue to be ill-defined but have focused on demonstration, visualization, and the use of satellite communications technology (Direct PC) to transmit data files. It is anticipated that the Center's scope of work will be finalized by December 1996 and work begun thereafter.

#### **6.2.2 National Lockheed Simulation-Based Design Program**

Orange personnel attended the first Simulation-Based Acquisition Workshop last quarter. A follow-up meeting was scheduled at Electric Boat in July; Orange personnel attended and participated. As a result of this meeting, clearer areas of focus were delineated.

### ***McDonnell Douglas Implementation of Newport News Smart Product Model***

James Rossie from McDonnell Douglas visited the Center last quarter. McDonnell Douglas is under contract with DARPA to demonstrate the application of the Newport News Smart Product Model to aircraft design. Follow-up meetings have resulted in the identification of specific work for the Center. A draft subcontract has been developed between McDonnell Douglas and the Center. Implementation is anticipated by October, 1996. At least one additional staff member will be retained and assigned this project. It will require C++ programming expertise.



### **6.2.3 Next Steps**

#### **6.2.3.1 Development of SBD Projects**

##### ***Distributed Collaborative Design***

American Bureau of Shipping (ABS): ABS senior management have visited the facility and toured the technology demonstration at the American International Shipbuilding Exposition (AISE) held in April in New Orleans. ABS personnel also participated in the Center's demonstration of collaborative design review at the AISE. As a result, staff have been working with ABS in Houston to identify areas of investigation that will reduce the time for design review and approval. Such areas include electronic submittal of drawings, use of collaborative design technologies (such as e-mail, the Internet, video-conferencing, shared work electronic spaces, etc.), review of 3 dimensional CAD models, and validation of product model data.

Due to issues with ABS, this project schedule was modified. In addition, ABS has requested that the scope of work, first discussed, be broadened. Subsequent meetings have occurred. At this time, a new and revised proposal is being developed for submission to the GCRMTC for GIAB review. It is anticipated that internal as well as external resources will be required for this project.

A draft project proposal has been submitted by ABS. This will be reviewed by Center staff for consideration of the GIAB.

Chevron Offshore: Chevron requested a demonstration of the Center's visualization technology and provided the Center with a model of an offshore platform; staff converted the model, created the visualization, and returned 20 minutes of video tape of a walk through of its platform. Subsequent to this initial work, Mr. Sheldon Fontenberry at the Chevron Research Center in New Orleans, has requested follow-up meetings to identify areas of mutual interest and activity. Meetings will be scheduled in November 1996.

Brown & Root: Brown & Root has advised us that it is interested in adopting SBD technology in its design and engineering operations. Further discussions with Brown & Root management are awaiting the hiring of new staff.

### **6.2.4 Administrative**

#### **6.2.4.1 Staffing**

The SBDC reviewed its human resource needs (in light of the resources available on the UNO campus) and created a staffing plan appropriate to the Center's thrust. The review included, as well, the needs of subcontracts.

Six (6) positions have been advertised. Interviews have been completed for the first round of new staff. Offers will have been made by the end of this quarter with new staff on-board in



October. The initial hiring will include 3 individuals. Two (2) additional professionals will be identified in November.

In addition to these activities, one position (network manager) has been modified. Its new focus is to include project work as well as network and information systems responsibilities. It is anticipated that this will be completed and finalized by October 1996.

As the Center undertakes additional subcontract work, staffing needs will be evaluated. New positions will be sought on a project-by-project basis.

#### **6.2.4.2 Planning**

The additional professional staff, the integration of the two sites under one level of management, and the implementation of several subcontracts prioritizes the need for additional strategic planning within the Gulf Coast Region Maritime Technology Center.

An initial planning session was conducted in New Orleans during July 1996. Follow-up meetings with other Department of Defense personnel are planned. This continues to be an important requirement in the overall planning function.

Internal planning has begun and will move forward as new staff join the Center and begin to interact with their colleagues at the New Orleans site as well as throughout the industry. Refinement of the Center's responsibilities within the *simulation-based design program* must be completed during the upcoming quarter. Completion of subcontracts and the exploration of additional externally-funded projects takes on added importance as the industry transitions into an international arena. Hardware and software updates must be completed insuring that the industry has access to those tools which support their competitiveness.

Each of these functions will be evaluated based on the Center's mission, the needs of industry, and the availability of resources. A draft planning document will be produced within the upcoming quarter for review by the Executive Director.

### **6.3 Marketing Resource Center (MRC)**

The focus of the Marketing Resource Center is to help the maritime industry access relevant data, interpret that information and utilize it in planning strategies to increase market share in all areas related to maritime industries. The Center is in the formative stage at present.

An exhaustive study was carried out to understand how others around the world approach marketing. Shipyards, research centers and support industries, located around the world, were visited by a team from the GCRMTC. Interviews were conducted with many U. S. based firms to assess how we approach marketing. A report has been submitted to the Government Program Manager for approval. These studies formed the basis for preliminary planning to initiate the MRC. Meetings were held with trade associations representing the industry to evaluate strategies and refine the Center's thrust. Further analysis will be carried out with the GIAB to determine



support for the Center and the extent to which it can provide the level and scope of services appropriate to the maritime industry's needs.

## 7. NEW ORLEANS SITE ACTIVITY REPORT

### 7.1 Internal Research Projects

Currently there are 14 research projects in various stages of progress. Quarterly reports of these research projects are attached as appendices to this report and listed below. Project AMTC96-053A commenced in late August 1996. Two additional projects are pending GPM review.

<u>GCRMTC Project No.</u>	<u>Title</u>	<u>Appendix</u>
AMTC95-001A	Inexpensive Non-Toxic Pigment Substitute for Chromium in Primer for Aluminum Substrate	B
AMTC95-008A	Integrated Environmental Management Plan for Shipbuilding Facilities	C
AMTC95-010A	UNO-Swiftships Development of a Cost Effective Aluminum Catamaran Structure	D
AMTC95-014A	Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring	E
AMTC95-016A	Research in Shipboard Sensors	F
AMTC95-018A	Reliability, Availability, and Maintainability (RAM) Database/SHIPNET of Ship Operations Cooperative Program (SOCP)	G
AMTC95-027A	Software Applications for Shipbuilding Optimization	H
AMTC95-030A	Improving Technology in the Shipbuilding Industry	I
AMTC95-035A	Low Cost Digital Image Photogrammetric Technology in Shipyards	J
AMTC95-036A	Ship Capsizing (an Accurate and Efficient Technique to Predict Ship Roll Damping)	K
AMTC96-032A	Evaluation of Cr(VI) Exposure Levels in the Shipbuilding Industry	L
AMTC96-033A	Integrating Fire-Tolerant Design and Fabrication of Composite Ship Structures	M
AMTC96-041A	Shock Reduction of Planing Boats	N
AMTC96-053A	Ship Propeller Thrust and Torque Management	O

### 7.2 Subcontracted Research

Based on the proposals submitted in response to RFPs issued in July 1995, contracts have been awarded by the GCRMTC effective June 1, 1996 as follows:

<u>Title</u>	<u>Contractor</u>
1. Automated Machine Learning of Diesel Engine Operating Characteristics	MACSEA Ltd.
2. An Investigation of the Expansion of the GCRMTC Ships' Reliability, Availability and Maintainability (RAM) Database	Rockwell International



3. Development of a Portfolio of Ship Designs

Rosenblatt & Son, Inc.

4. Automated Off-Line Programming: A Strategic Tool  
to Link the Design and Manufacturing Processes

CYBO Robots, Inc.

Initial progress reports are attached as appendixes P through S.

### **7.3 Infrastructure Build-up Status**

The bulk of the infrastructure equipment directly associated with the first phase of ongoing research projects has been received or has been ordered. Some of the infrastructure equipment planned for the Center/New Orleans Site has been held in abeyance due to uncertainties involving receipt of appropriations.

### **7.4 Education and Training**

Regional workshops are planned for New Orleans as discussed in section 5.1.2. An earlier planned workshop for September had to be postponed due to lack of interest. Additional workshops are in the planning stages.

Biweekly seminars are continuing to be held on the research projects in progress. Two projects are presented at each seminar. The primary goals of the seminars are to a.) inform the PIs and their researchers about all the ongoing research, b.) to encourage interactions and exchange of ideas among the researchers and their industry collaborators, and c.) to inform other faculty members of the opportunities available for research projects.

### **7.5 Shipbuilding Machinery & Marine Technologies (SMM '96)**

The Center, New Orleans Site, and the Orange Site will set up and staff an information booth at the SMM '96 on October 1-6, 1996 in Hamburg, Germany.

## **8. ORANGE SITE ACTIVITY**

During this quarter the Orange Site has continued to pursue activities consistent with its mission and has developed successful relationships within the marine industry and those technology organizations which develop tools applicable to the Center's goals. The staff continues to develop its expertise and experience in those technical areas which advance the integration of new tools into the maritime industry. A strong association with the resources on the campus in New Orleans has presented unbounded opportunities for success for the Orange Site. Weekly meetings take place to insure close coordination of activities.

The draft report from OR95-002B Ship Repair Market Study and OR95-001A Business Process Improvement Gulf Copper Manufacturing, Inc. are complete and have been forwarded to the



Executive Director of the GCRMTC as required by the Procedures Manual. The final drafts are being modified in accordance with the review comments received. OR95-005A Marketing Resource Center Feasibility Study has been forwarded to the Executive Director of the GCRMTC for review and comments. The final report from OR95-003, Japanese Translation Project is awaiting approval from the Ship and Ocean Foundation (of Japan) for public distribution.

The Orange Site staff has participated in planning meetings with the team members for the Maritech projects in which this site has been included. The project entitled *SBD as an Environment for Concept and Contract Design Using IPPD* which includes Avondale Industries, Intergraph Corporation, General Dynamics Electric Boat Corporation, and the Institute for Competitive Design is underway. One additional staff member has been retained to fulfill the contractual requirements of this project: he is located on-site at Avondale. The Center has been included in the project entitled *Development of an Integrated Product and Process Data Environment to Revolutionize Shipbuilding Processes* which includes Hughes Aircraft, Advanced Marine Enterprises, Orincon Corporation, Intelligent Systems Technology, American Bureau of Shipping, and Mr. Lou Chirillo. Meetings have taken place; however, the Center's role has yet to be refined. It is anticipated that the work requirements will begin in 1997. Both of these projects are coordinated with the campus' School of Naval Architecture and Marine Engineering Program insuring that appropriate and applicable resources and expertise are available for overall project success. Additional information is noted in Section 5.2.1.

In addition to the Maritech projects, McDermott Shipbuilding, Inc. has issued a procurement order for simulation and visualization activities as part of the Mobile Offshore Base System project (MOBS). The project began in September 1996. The first phase of activity is scheduled for completion in the spring of 1997. Additional staff resource requirements have been identified. As part of this project, new software (WAMIT) which has been developed by the Massachusetts Institute of Technology has been acquired. This tool will be utilized, as appropriate, in other projects and has been acquired with SBD funds. One additional staff member has been retained to provide technical assistance. This individual possesses technology-based animation and simulation development skills and will be pivotal to the overall success of this component of the Orange Site's responsibilities.

Exploratory discussions have taken place regarding the Orange Site's participation in the Advanced Amphibious Assault Vehicle (AAAV) for the Marine Corps. This project would expand the Site's capabilities and resource base through a strategic partnership with Deneb.

The Orange Site staff has met with officials of McDonnell Douglas and is finalizing a subcontractual relationship to assist in the evaluation and analysis of the Newport News' Smart Product Model and its application within the aerospace industry. This project will require the addition of professional staff thus expanding the resource base of the Center and enhancing the core capabilities of the staff. In addition, McDonnell Douglas has proposed a major project to the Center which would focus on the next generation of aircraft carrier. The Executive Director has received a draft of this proposal.



The Orange Site staff continues to participate in the simulation-based design program with Lockheed Martin, NAVSEA, and other members of the team; however, the specific roles and responsibilities of this participation have yet to be defined. This will become a priority during subsequent quarters as the Site enhances its core capabilities and refines its thrust in simulation based design activities. Of particular import to this task is close coordination with the Office of Tactical Technology within the Defense Advanced Research Projects Agency.

In response to the need to refine this role and to insure a smooth transition into the University of New Orleans, an initial planning session was conducted in New Orleans in July. Site accomplishments were reviewed, industry needs were discussed, and resource capabilities were evaluated. Of particular import was the need to refine the Site's role in simulation based design, virtual reality, and information technologies. Subsequent planning meetings with other Department of Defense personnel were identified as essential to augment the strategic planning process particularly as it relates to simulation based acquisition and the integration of Orange activities with other Navy Centers of Excellence.

The Orange Site continues to develop its relationships with industry partners and technology sources. Project concepts with the American Bureau of Shipping, Ingalls Shipbuilding, and Avondale Industries are in discussion stages. Staff members are also discussing applications of available technologies with CadCentre, Deneb, SDRC, and Computervision. In September, meetings were conducted to refine the DDG Dynamic Aircraft project. Follow-up meetings are being scheduled.

The Site hosted a delegation from Ball Industries and Wright-Patterson Air Force Base. The purpose of this meeting was to present an overview of the Center's resources and provide a "lessons learned" briefing to the Wright-Patterson staff.

The following narrative details Site activities in the last quarter:

## **8.1 Facilities**

Orange Site facilities continue to be made available to Lamar University faculty through a cooperative agreement with the University of New Orleans.

### **8.1.1 Hardware**

The New Orleans site has received equipment which will enhance the link between both sites. A portable Silicon Graphics Indy Workstation was ordered to insure that off-site demonstrations are presented effectively with equipment which is representative of the GCRMTC and for reasons of portability. A high-end data back-up system has been installed which has reduced the time of scheduled (file) back-ups by 80 percent.



### **8.1.2 Software**

WAMIT software, the industry standard for analyzing wave interactions, has been purchased and installed. This software is being utilized currently to convert response amplitude operators (RAO) data to simulate ship motions in the MOB's project. Deneb software is being evaluated, currently, as part of a Marine Corps/AAAV project.

## **8.2 Technology Development and Education and Training**

### **8.2.1 Technology Development**

#### **8.2.1.1 National**

##### ***National Shipbuilding Research Program:***

The Orange site has been refining several National Shipbuilding Research Program (NSRP) proposals in an effort to provide the resources for implementation. Within previous quarters, these projects underwent a variety of modifications. During this quarter, and since the last report, supporting documentation has been provided for seven (7) of the proposals. These have been submitted to the State of Louisiana contract office by the Executive Director. The University of New Orleans' Office of Research is in the final stages of executing purchase agreements for the approved projects.

The approved projects include:

- NSRP 9-95-3 Two Interactive Multimedia Training Modules
- NSRP 9-96-1A, B, C Assist U.S. Shipyards to Develop and Maintain Skilled Trades  
and NSRP 9-96-2 Workers and Structured On-The-Job Training
- NSRP 4-95-2 Implementation and Update Of The Design For Production Manual
- NSRP 6-95-2 Develop Leapfrog Technology to Standardize Equipment and  
System Installations
- NSRP 8-96-3 Application of Industrial Engineering Techniques To Reduce  
Worker Compensation and Environmental Costs
- NSRP 6-96-2 Vendor Furnished Information (VFI) Guidelines
- NSRP 4-96-1 Activity Analysis for a World Class Design Model

### **Simulation of Outfitting Processes in New Ship Construction**

The project "Simulation of Outfitting Processes in New Ship Construction", has been submitted for approval. This project included Avondale Industries as the maritime partner. The project's focus is on four major business units for baseline modeling: machinery, pipe fitting, electrical, and sheet metal. The project will demonstrate current work processes and challenge basic assumptions of the execution of work. Simulation will allow comparing and contrasting of



“what if” scenarios to pinpoint developmental areas and opportunities for improvement in the outfitting process in new ship construction. Additionally, it seeks to reduce the risk and cost associated with innovation.

Due to the high cost of the project the Government Program Manager recommended to the Executive Director that the effort be undertaken as an in-house project. This has been discussed with Avondale Industries. An additional project engineer will be required to undertake this effort. It is anticipated that the project will be underway prior to the next scheduled Government Industry Advisory Board meeting in December 1996. This activity is vital if the industry is to adapt, successfully, technology tools to enhance design to manufacturing capabilities.

## **8.2.2 Education and Training**

### **8.2.2.1 Regional and National**

Access to the Orange Site is available through ordinary Internet connection. Efforts are still underway to connect the University of New Orleans via a T-1 link. This task was expected to be complete by the end of May 1996, but has been given a lower priority due to other demands. To date, the task is incomplete. Among the issues to be resolved is the form of communication linkage. Because the sites are served by two different regional phone companies the initial cost for service is high. Deregulation of the industry is providing other options to implement this linkage.

In September 1996, the Orange site provided direct access to the Webb Institute for Naval Architecture. Students will be working with site staff to provide technical support to specific projects. Webb students will then locate to the Orange site during the January and February 1997 period to complete project activities. Webb Institute faculty will have access to the Center's resources as well. This association has expanded the Center's resource base with respect to marine engineering.

### **8.2.3.2 National**

#### **National Shipbuilding Display Booth**

The booth developed for the AISE held in April in New Orleans has been shipped to ONR facilities in Washington DC. Plans for future deployment are being discussed with the executive directors of the industry trade associations. The Orange Site participated in the development and submission of a Department of Commerce competitive grant award to provide funds for future use of the facility.

#### **Industry Internship (in progress)**

The Orange Site continues to host industry personnel. As previously stated, Vibtech and UNO have visited the facility for orientation. Requests for visits have been received from several



foreign organizations. These have been forwarded for required government approvals through the Executive Director.

#### ***Translation of Japanese CIM Project Report (complete)***

This project is complete. The final report has been forwarded to the Executive Director for review and release.

Due to a copyright issue, the report cannot be released. Contacts have been made with the appropriate Japanese officials to obtain approval to release the document. This should be completed within the next quarter.

#### **8.2.4. Marketing Resources**

##### **8.2.4.1 National**

#### **Marketing Resource Center Feasibility Study (complete)**

The Orange Site staff has completed the first draft of the final report. This draft is under review and revision. This project has reviewed models for similar centers, resources available, industry characteristics, and industry needs. The result is development of four configurations, assessment of the viability of each option, and recommendations related to creating a marketing resource center.

The Orange Site participated in the development and submission of a Department of Commerce competitive grant award to provide funds for the implementation of a proposed model identified in the research. The Site awaits notification from the Department of Commerce.

### **9. GCRMTC ACTIVITIES PLANNED FOR NEXT QUARTER**

In addition to the future work described in previous paragraphs and in the individual projects in the Appendices, work is planned over the next quarter in the following areas:

- 1) Recommendations concerning New Orleans and Orange Site proposals and issuance of RFPs will continue to be made by the Center.
- 2) Work will continue under the four subcontracts awarded in June 1996. A progress meeting will be held in mid December with the GPM.
- 3) Peer review and evaluation of the Concept Proposals received as a result of the July solicitation will be continued.



- 4) Purchase agreements will be executed for the seven NSRP projects discussed in section 8.2.1.1.
- 5) The Marketing Resource Center Feasibility Study was completed and forwarded to the Government Program Manager and will be released on approval of the GPM.
- 6) Interim and/or final research reports will be printed and published as they are approved by the GPM.
- 7) The plans to connect the New Orleans Site to the Orange Site via a T-1 link will be completed during the next quarter.
- 8) The Center and both sites will participate in the SMM '96 Exhibition and Conference in October 1996 in Hamburg, Germany.
- 9) The Center will increase its efforts to provide workshops for the maritime industries.
- 10) Plans will be formulated to host the December 1996 GIAB meeting in New Orleans.

## 10. SUMMARY

The GCRMTC objectives and milestones as defined by the Cooperative Agreement continue to be met in a timely fashion. The achievements of the two Sites and the Center during the third quarter of 1996 were as follows:

- 1) The Center issued a second round of three RFPs near the end of the last quarter based on GIAB recommendations and received four proposals which were peer reviewed and ranked during the current quarter. These recommendations will be transmitted to the GPM for his decision regarding funding.
- 2) A master schedule for all GCRMTC activities has been included as Appendix A for reference.
- 3) The Center is in the process of issuing agreements to fund seven NSRP research projects at a cost of \$1.7 million based on commitments to the Executive Control Board of the NSRP and the NSRP Panels by the Orange Site some time ago.
- 4) A third solicitation for Concept Proposals was issued in January 1996 and these external and internal concept proposals were peer reviewed and considered by the GIAB in May 1996. Recommendations were submitted to the GPM for funding of internal proposals. Recommendations will be submitted for issuance of RFPs for external concept proposals during the next quarter.



5) ERIC and SBDC are fully operational and actively addressing their respective missions. Their activities are delineated in sections 6.1 and 6.2 respectively. The Marketing Resource Center is in the formative stage at present as described in Section 6.3.

6) The GCRMTC and its sites have made extensive plans to set up and operate a booth at the SMM '96 (Exhibition and Conference) in Hamburg, Germany October 1-5, 1996.

7) Research projects are ongoing at both sites and the status of 14 projects are appended.

## **11. RECOMMENDATIONS**

Based on a review of the last quarter's activities of the Center, the New Orleans Site, and the Orange Site along with the feedback from the Program Manager and Staff, the following actions are recommended:

1) Upon approval from the GPM of the May 1996 GIAB Meeting recommendations, initiate internal proposals and issue appropriate RFPs for external proposals.

2) Issue the agreements funding the seven NSRP projects discussed in section 8.2.1.1 at \$1.7 million.

3) Continue arrangements for the Center and its two sites to set up and operate a booth in the U. S. Pavilion at the SMM '96 (Exhibition and Conference) in Hamburg, Germany October 1-5, 1996.

4) Recognizing the uncertainty in the amount of FY96 funding, prepare contingency operational plans for the Center.

5) Finalize personal selection for the Marketing Resource Center and solicit clients and partnerships.

6) Plan and hold the semi-annual GIAB meeting on December 12, 1996 at the University of New Orleans.

7) Continue planning for a workshop for January 1997 to revisit the Orange Site mission.



# **APPENDIX A**

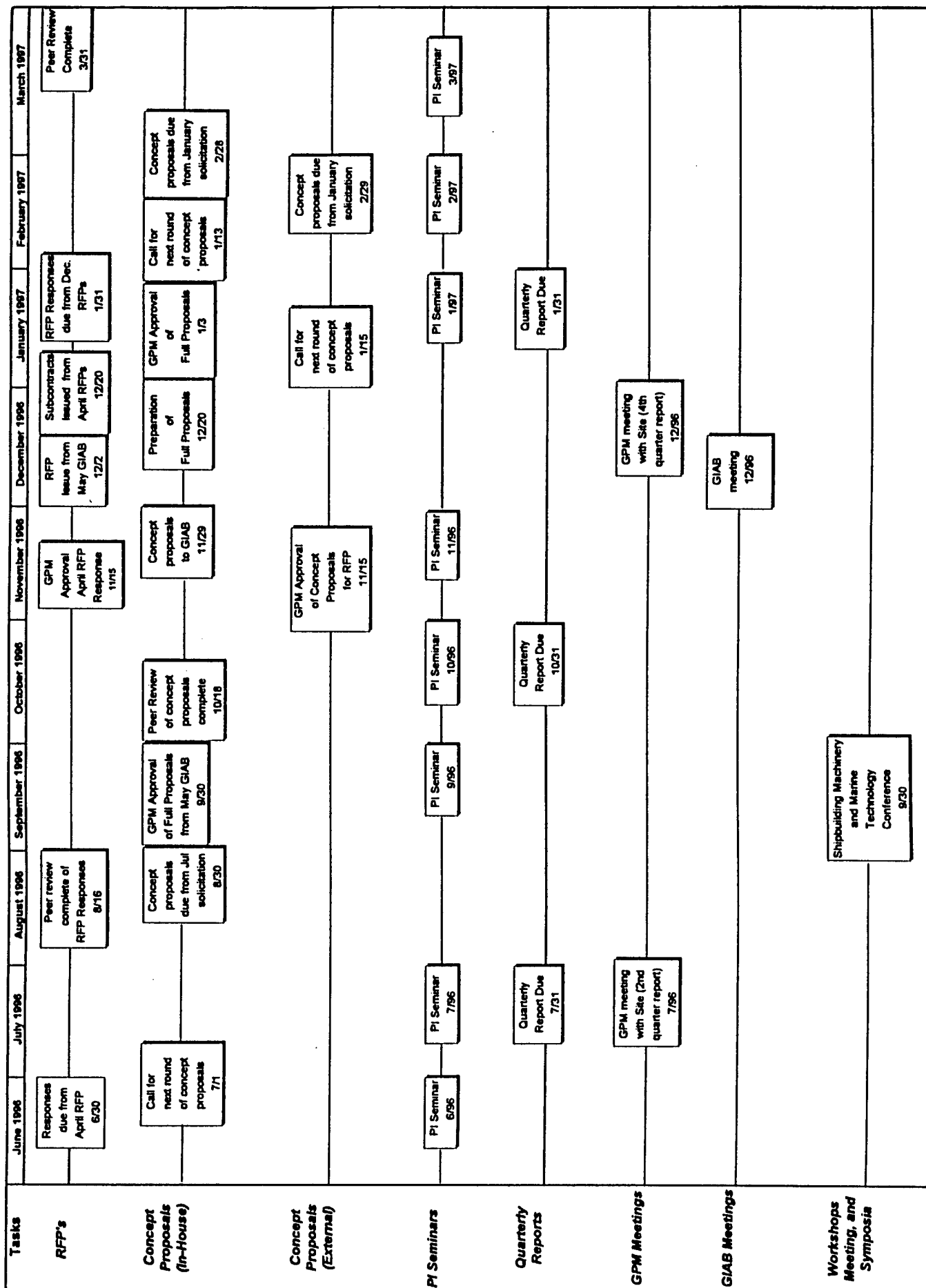
## **GULF COAST REGION MARITIME TECHNOLOGY CENTER**

### **MASTER SCHEDULE**

**University of New Orleans  
New Orleans, LA 70148**

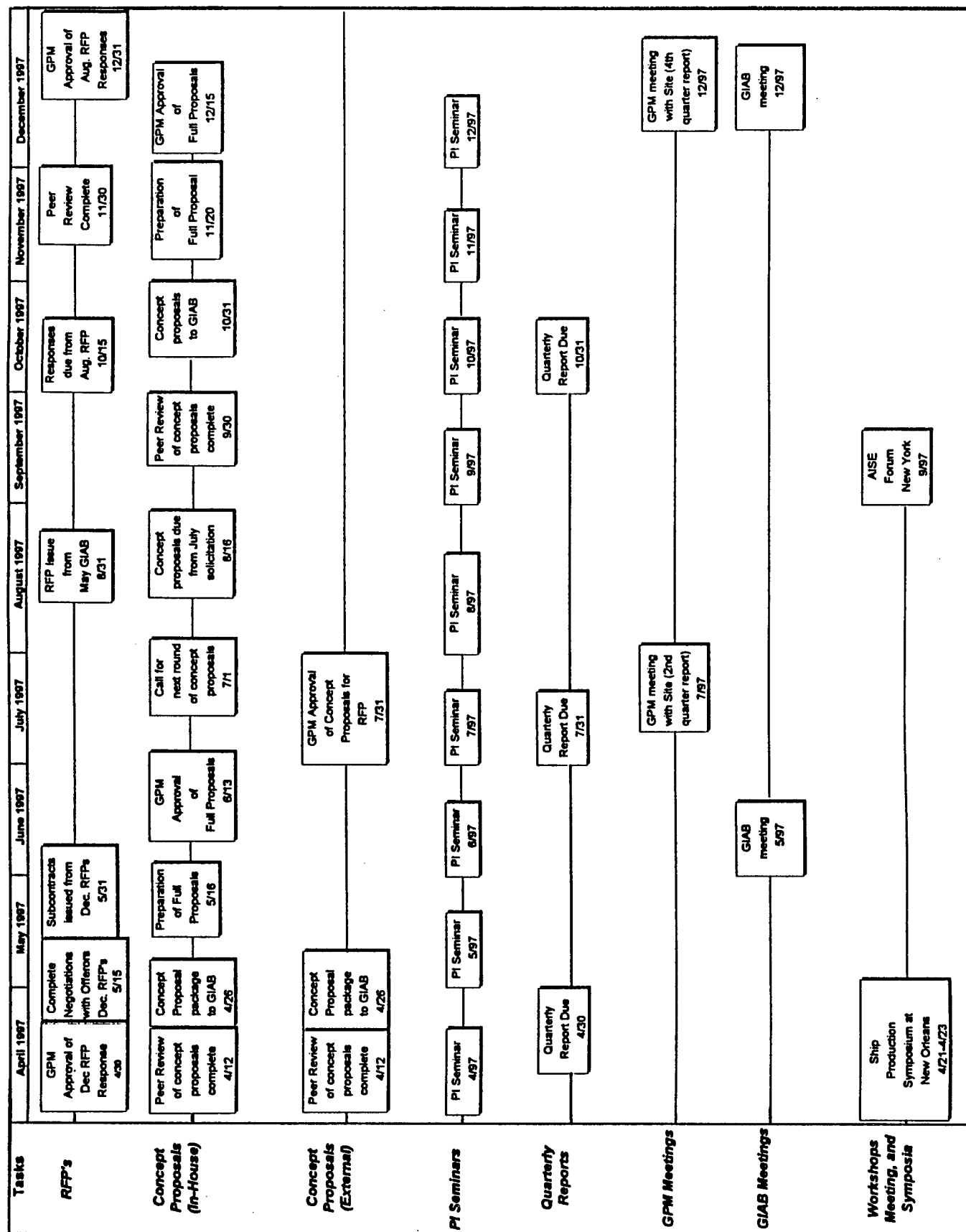


# Gulf Coast Region Maritime Technology Center and New Orleans Site Master Schedule





# Gulf Coast Region Maritime Technology Center and New Orleans Site Master Schedule





# **University of New Orleans, GCRMTC/Orange - Site Program Master Schedule**

<b>Name</b>	<b>Planned Start</b>	<b>Planned Finish</b>	<b>Actual Start</b>	<b>Actual / Projected Finish</b>	<b>% Done</b>
Administrative / Program Transition Issues	5/1/96	8/31/96	5/1/96	8/31/96	100
Core Staffing	7/19/96	12/31/96	8/12/96	12/31/96	50
Project Staffing	8/12/96	1/31/97	8/12/96	1/13/97	20
Strategic Planning-External	7/1/96	9/30/96	7/1/96	12/31/96	50
Strategic Planning-Internal	9/1/96	12/31/96	9/3/96	12/31/96	25
Staff Realignment	9/1/96	12/31/96	9/3/96	12/31/96	35
External Project Development & Funding	3/1/96	9/30/97	3/1/96	9/30/97	25
Equipment Upgrade Evaluation & Procurement	5/1/96	2/28/97	5/14/96	2/28/97	67
Software Upgrade Evaluation & Procurement	5/1/96	3/31/97	6/3/96	3/31/97	60



**University of New Orleans, GCRMTC/Orange - Site Project Master Schedule**

<b>Name</b>	<b>Planned Start</b>	<b>Planned Finish</b>	<b>Actual Start</b>	<b>Actual / Projected Finish</b>	<b>% Done</b>
Mobile Offshore Base Project	5/15/96	4/1/97	9/5/96	4/1/97	10
SBD As An Environment For Concept and Contract Design Using IPPD	7/15/96	1/31/97	7/15/96	1/31/97	35
SMART Product Model Project	9/1/96	12/31/97	9/1/96	12/31/97	2
Virtual Shipyard Project	9/1/96	12/31/97	9/1/96	12/31/97	2
Marketing Resource Center Feasibility Study	7/1/95	8/31/96	7/1/95	8/1/96	100



# **APPENDIX B**

## **INEXPENSIVE NON-TOXIC PIGMENT SUBSTITUTE FOR CHROMIUM IN PRIMER FOR ALUMINUM SUBSTRATE**

**GCRMTC PROJECT NO. AMTC95-001A**

**Principal Investigator: Alfred F. Daech**  
Department of Civil and Environmental Engineering

**Additional Researcher: Kenneth L. McManis**  
Department of Civil and Environmental Engineering

**Additional Researcher: Nikhil K. Sarkar**  
Department of Biomaterials - LSU Medical Center

**Research Assistant: Li Li**  
Department of Civil & Environmental Engineering

**Research Assistant: Raisa Moiseyeva**  
Department of Biomaterials - LSU Medical Center

**University of New Orleans**  
New Orleans, LA 70148



**PROJECT SYNOPSIS:** Lithium Carbonate in solution has been shown to protect certain metals, particularly aluminum, from corrosion by reacting at the surface. SIMS (Secondary Ion Mass Spectrometer) confirms this phenomena. Sodium carbonate and potassium carbonate reactions produce a soluble product and no alkali is detected on the surface by SIMS. Because of their high solubility and reactivity most "alkaline metal" compounds are not suitable for corrosion protection. Metallic aluminum normally provides its own corrosion protection due to its tendency to form an aluminum oxide insulator on the surface, but the matrix of hydrated aluminum oxide is penetrated by chemicals such as NaCl, acid and bases.

Engineers and scientists observed that certain aluminum-lithium alloys demonstrated some diffusion of lithium to the surface of the alloy. The lithium ion is so small that it penetrates the large interstitial spaces of the aluminum oxide layer. The aluminum - lithium alloys are stable in chemical composition at ordinary temperatures but a lithium-rich surface can be easily produced in the alloy by briefly heating to facilitate the migration. It appears that certain lithium alloys or compounds can be incorporated into a paint vehicle or otherwise deposited on the surface of aluminum alloys to provide corrosion protection when exposed to salt water, humidity and other corrosive environments.

The corrosion propensity of the various alloys of aluminum may be measured by electrochemical techniques. Electrochemical techniques of corrosion testing have continued to be attractive to investigators interested in corrosion. The imposition of a controlled potential via a potentiostat is a very attractive concept from a reaction kinetics point of view. Furthermore, electrical currents are simple to measure and can be directly related to electrochemical reaction rates through Faraday's Law. AC techniques can be used to determine film resistivity and thickness values. A variety of electrochemical tests have been proposed and developed. Scanning electron microscopy (SEM) and simple magnification of target metals illustrates the surface modification caused by the lithium salts. The problem is to select inhibitors, optimize them and to make them available to protect the aluminum substrates by a coating process.

The United States Navy has established an operations requirement for primers for aluminum which can be applied by personnel while on patrol. The desired product must be a fire retardant, general purpose primer which will be both protective for the exterior as well as the interior surfaces of aluminum. Material selection and usage are rigidly governed by codes; for example, those contained in proposed contaminant restrictions.

Chromium compounds provide outstanding corrosion protection of certain metals. Chromates are used in the chemical conversion coating of Aluminum, (MIL-C-5541). Chromates have reportedly been determined to be carcinogenic and therefore a replacement for them is currently being sought. Environmental Agencies limit the amount of chromium ion tolerated in waste water to less than one part per million. Thus an environmentally benign substitute is desired. Since most available corrosion inhibitors are based on heavy metals or reactive amides, the available alternates appear to fall short of the desired performance in corrosion inhibition and/or environmental suitability.



Various lithium compounds appear to offer a viable alternative to chromium using a new concept of corrosion inhibition, with a minimum of environmental impact. This research involves the creation of new primer inhibitors based on aluminum-lithium compounds and the development of a non-polluting paint vehicle which can be used as a primer.

#### **BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$149,899

FUNDS REMAINING: \$ 53,892

#### **ACCOMPLISHMENTS THIS PERIOD:**

##### **TASK I - Obtain Vehicles**

The pigments have been incorporated into various resins of the paint industry. These vehicles must be compatible and non-polluting.

Euronavy USA has provided some vehicles for our formulations:

Three types of epoxy based paint vehicle.  
One Styrene acrylic based latex paint vehicle.  
One Acrylic/vinyl thermoplastic paint vehicle.

These vehicles are being used or considered for use by the Navy. Two or three vehicles look especially promising and will be further tested. These will demonstrate the system.

##### **TASK II - Test Vehicles/Pigment Combinations**

Carboline's commercial product "Carbozinc" was investigated and the group of reformulated vehicles/pigment were tested for comparison (See Attachment I).

Other vehicles were and are being tested.

##### **TASK III - Lab Tests of Selected Paints**

Lab tests of selected paints was performed in this quarter. The fundamental piece of equipment used in the tests was the Model 352/252 Soft Corr<sup>TM</sup>II Corrosion Measurement & Analysis Software manufactured by EG&G Instrument Division



of Princeton Applied Research. The selected pigments were tested in combination with a vehicle to make paints. About 80 experiments were done in this quarter.

#### **TASK IV - Physical Tests of Paint**

Lithium compounds with different vehicles were reformulated and the paints were physically tested (cohesion force between paint and alloy surface). The brief description is in Attachment I.

#### **TASK V - Field Test of Paint**

This task was postponed by delays in funding. In lieu of this we are having paints tested to ASTM specifications by Southwest Research Center in San Antonio, TX.

#### **TASK VI - Manufacturing Methods**

This task will be completed once paint selection is made. EURONAVY will manufacture some of the paints. Others will be manufactured in the United States on other types of equipment.

#### **TASK VII - Reformulate**

The reformulation was done with lithium compounds, barium sulfate, mica, and other chemicals from FMC company such as Belcor 575. The attempt was to get good adhesion and a homogeneous film (see attachment II).

#### **TASK VIII - Continuing Pigments Test**

The pigment variations are being tested as ideas are generated. The effectiveness of a multi-functional polymer in forming adherent protective coatings on Al-alloy surfaces was also studied in this quarter. Results are shown in Attachment II.

#### **TASK IX - Argon Oven**

The oven is being installed. We will use the Argon oven to convert aluminum-lithium alloy into an aluminum particle "plated" with lithium. The oven is now in place and the vendor has arranged to verify the operation.

#### **TASK X - Surface Analyses**

Surface analyses have been done on reformulated paints and on multi-functional polymer treatment to aluminum. Some of the scanning electron microscopy (SEM) photos are attached in Attachment III. The continuity of deposits on the surface was investigated.



## **PROPOSED ACTIVITIES NEXT PERIOD:**

### **TASK I - Obtain Vehicles**

The vehicles on hand are representative of typical ones. No more are planned.

### **TASK II - Test Vehicles/Pigment Combinations**

A set of panels will be tested per ASTM G85 and ASTM B287 at Southwest Research in San Antonio.

### **TASK III - Lab Tests of Selected Paints**

Lab tests will continue of the promising combinations to provide a formula or formulas for top paints.

### **TASK IV - Physical Tests of Paint**

Continuing work will be done on additives and ratios of ingredients for better physical properties.

### **TASK V- Field Test of Paint**

Field test of paint will be performed by Southwest Research Center in San Antonio in their paint testing labs in order to save time.

### **TASK VI - Manufacturing Methods**

Once the final paints are selected, the manufacturers and methods will be recommended.

### **TASK VII - Reformulate**

Reformulation will continue based on results of earlier tasks.

### **TASK VIII - Continuing Pigments Test**

Since pigments are the main goals of this project, sampling and testing will continue to the final report.

### **TASK IX - Argon Oven**

The argon oven will be used to prepare pigments. The manufacturer will train us in the second week of October.



# **TASK X - Surface Analyses**

Surface analyses work will continue as the paints are reformulated.

## **COLLABORATIVE EFFORTS:**

	<u><b>THIS QTR</b></u>	<u><b>YTD</b></u>
<b>\$ VALUES OF SERVICES FROM INDUSTRY:</b>		\$ 5,000
IN KIND SERVICES (EXPERIMENTAL VEHICLES)		\$ 5,000
ACTUAL FUNDS:		NONE
<b>\$ VALUE OF EQUIPMENT FROM LSU (at cost)</b>	\$86,190	\$86,190
<b>\$ VALUES OF SERVICES FROM GOVERNMENT</b>		NONE
IN KIND SERVICES:	NONE	NONE
ACTUAL FUNDS:		NONE
<b># OF SIGNIFICANT CONTACTS:</b>		
INDUSTRY	3	11
ACADEMIC	1	6
GOVERNMENT	1	5

**COMMENTS:** Value of Scanning Electron Microscope based upon cost verified by original receipt.



## ATTACHMENT I TO APPENDIX B

### VEHICLES/PIGMENT REFORMULATION, TEST AND ANALYSES

We tested a silicate which will make a paint similar to Ameron's "Dimetcoat" or Carboline's "Carbozinc". These products use sodium silicate or partially hydrolyzed ethyl silicate and zinc dust. We are investigating a special silicate and an aluminum lithium dust. The zinc filled products are for steel and ours will be for aluminum. The standard electrode potential for Zinc is -0.76 and Iron is -0.44 which lithium is -3.045, while aluminum is -1.67 (Volts as compared to Hydrogen). Thus zinc protects iron (being more electronegative) and lithium should protect aluminum.

From the literature of lithium silicate solution, the salt will precipitate when other lithium salts are added several ways have been tried to get the matrix solution with 20% lithium silicate. One way is dissolving the salts in a very small amount of water to make the solution first, and adding the lithium silicate solution and mixing. The second method to make the matrix solution is to add the salts to the 20% of lithium silicate solution and mix well (ignore the precipitation). The results are shown as following:

**TABLE I**

Chemical Identification	Method 1 Dissolve/ Precipitate	Method 2 Dissolve/ Precipitate	Method 3 Dissolve/ Precipitate	Evaluation of being used as primer
$\text{Li}_2\text{MoO}_4 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	Precipitate	Dissolve	Dissolve	Big crack and peeled off
$\text{Li}_2\text{CO}_3 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	no reaction	no reaction	no reaction	medium crack
$\text{LiNO}_3 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	Precipitate		Dissolve	medium crack
$\text{Li}_3\text{C}_6\text{H}_5\text{O}_7 \cdot 4\text{H}_2\text{O} + 20\% \text{Li}_2\text{SiO}_3\text{-6}$			Dissolve	
$\text{LiC}_2\text{H}_3\text{O}_2 \cdot 2\text{H}_2\text{O} + 20\% \text{Li}_2\text{SiO}_3\text{-6}$			Dissolve	
$\text{Li}_2\text{TiO}_3 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	no reaction	no reaction	no reaction	Big crack
$\text{Li}_2\text{SO}_4 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	Precipitate	Dissolve	Dissolve	Big crack
$\text{HCOOLi} \cdot \text{H}_2\text{O} + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	Precipitate	Dissolve	Dissolve	Big crack
$\text{LiH}_2\text{PO}_4 + 20\% \text{Li}_2\text{SiO}_3\text{-6}$	Precipitate	Precipitate in 3 seconds	Dissolve	small crack
Talc	no reaction	no reaction	no reaction	small crack
H2I4G4 (#133)			Dissolve	Crack
H3I1G2C4 (#147)			Dissolve	Crack



H4I4C4(#146)			Dissolve	Crack
Carbo Zinc 11 pigment base*				very fine crack (see Fig.1 & 2)
Carbo Zinc 11 Base* + zinc powder 3:2				OK (see Fig. 3)
Carbo Zinc 11 Base + Al-Li (80 mesh) powder 2:1				Better than zinc powder but finer powder will be better (see Fig. 4)
Carbo Zinc 11 Base + Li <sub>2</sub> SiO <sub>3</sub> powder				mud cracked and peeled off very fast
Carbo Zinc 11 Base + Li <sub>2</sub> CO <sub>2</sub>				OK but less bonding force than AL-Li
Carbo Zinc 11 Base + Mixed powder : Li <sub>2</sub> O-- 2.8%, Al <sub>2</sub> O <sub>3</sub> -- 2.5% CaO-- 6.0% SiO <sub>2</sub> -- 63.5%				Smooth paint, but the paint layer later cracked and peeled off

Note:

\* Carbo Zinc 11 is a registered trademark of the Carboline Company of St. Louis, Missouri. The pigment base is a modified partially hydrolyzed ethyl silicate.

1. Method 1: dissolve salts in small amount of water and then mix with +20% Li<sub>2</sub>SiO<sub>3</sub>-6.
2. Method 2: mix powder of salts with +20% Li<sub>2</sub>SiO<sub>3</sub>-6 directly.
3. Method 3: mix powder of salts with +20% Li<sub>2</sub>SiO<sub>3</sub>-6 directly and stay overnight.



## **Discussion:**

From above experiments, silicate solution can dissolve most of the lithium salt individually or jointly, but as a pigment the aluminum-lithium powder greatly improved the mud cracking. Work will be needed on additives.

For the Carbo Zinc 11 pigment base test, the base itself as paint looks good by the unaided eyes, but under the microscope cracks can be seen (see Figure 1 and Figure 2). After adding the zinc powder and aluminum-lithium powder, the results are very good, even on the microscopic pictures (see Figure 3 and Figure 4). The ratio of the Carbo Zinc 11 Base\* to zinc powder is 3:2 by weight. The ratio of the Carbo Zinc 11 Base\* to Al-Li powder (80 mesh) is also 2:1 by weight. The results showed that the bonding force on the aluminum plate surface (polished by 150 grit sand paper) is good enough. Mud cracking occurred when the paint was too thick. Apparently the ratio of Carbo Zinc 11 to either the Al-Li powder or zinc powder is very important and also the mesh of the powder is critical. Since Al-Li is much less dense than zinc ratios of 1 part resin to 2.0 parts aluminum powder worked well.

## **Summary:**

It appears that the lithium pigments can be successfully incorporated into inorganic bases such as the partially Hydrolyzed Ethyl Silicate and the Lithium Silicate but more work is required to optimize. Other vehicles such as latex, acrylic and epoxy are being evaluated.



## **ATTACHMENT II TO APPENDIX B**

### **MODIFICATION AND PIGMENTS TEST**

The exploratory work performed during this quarter was aimed at producing Li (Lithium) and Non-Li containing coating on aluminum and an Al (Aluminum)-alloy. If these coatings are sufficiently corrosion resistant, they can be used as substitutes for chromate conversion coatings. The general methodology employed in producing the above mentioned coatings was as follows. The metallic coupons were immersed in salt solutions. Following exposure of the coupons for a certain period of time the specimens were withdrawn from respective solutions, rinsed thoroughly with distilled water, air dried. Later, scanning electron microscopy (SEM) was used to characterized the nature of the surface of each coupon. Typical SEM micrographs illustrating the representative surface morphology of various coupons are shown in Figures 5 through 13 and are discussed in Table II.

The research carried out during the last quarter at the dental school had two objectives. One was to modify the composition and morphology of Li-containing reaction products, that form on Al-alloys exposed to Li-containing electrolytes. Al-aluminate crystals form a porous network (Figure 5) and are somewhat soluble in aqueous environments. The other objective was to study the effectiveness of a multi functional polymer in forming adherent protective coatings on Al-alloy surfaces. The use of multi functional polymers to inhibit corrosion of metallic materials has received attention lately. (Materials Performance, June, 1996, LL. 41-47).

#### **Modification of Lithium Aluminate Crystal Morphology and Composition**

Incorporation of other metallic ions in the Lithium Aluminate lattice is one way of accomplishing this object. In the present study, several metallic ions, namely,  $Ba^{++}$ ,  $Zn^{++}$  and  $M^{+}$  are being investigated for this purpose. The SEM micrographs showing  $Ba^{++}$  modified Lithium Aluminate crystals on the surface of alloy Al3003 are shown in Figs 6 and 7. The outline of the procedure employed is given in Table 2. When compared to unmodified Lithium Aluminate (Figure 5), the  $Ba^{++}$  modified crystals are seen to be thicker and denser. Treatments using salts of  $Zn^{++}$  and  $Mn^{+}$  as in progress.

#### **Multi functional Polymer Treatment**

The polymer used for this application is a phosphono-polycarboxylic acid (POCA) Belcore 575, available from FMC Corporation. Both phosphonates and polycarboxylic groups have the ability to form insoluble complexes with aluminum. Details of different treatments using POCA (pH=1.96) and POCA modified with LiOH (pH = 11.8) are shown in Table 2. Treatment of Alloy Al3003 with POCA (pH = 1.96) led to slight corrosion of the alloy (Figure



8). Corrosion was enhanced when the temperature of the electrolyte, Belcor 575, was raised (Figure 9). Treatment of the same alloy with the Li containing POCA at a higher pH (11.6) led to the formation of adherent deposits on the alloy surface (Figure 10). The space seen in between the islands of deposit results from cracking of the deposit due to drying. Vigorous ultrasonic cleaning was found to break off these deposits at their points of attachments on the alloy substrate (Figure 11). A cross-section of the deposit layer is shown in Figure 12. The deposits thus formed were subject to long term corrosion in NaCl solution. SEM examination of the surface following this treatment indicated that the coating formed with phosphono polycarboxylic acid remained unattacked (Figure 13) and is thus resistant to corrosion.

**TABLE II**  
**CONDITIONS FOR VARIOUS TREATMENTS**

Samples #	Solution	pH	Time
1	Li-Nitrate	6.47	18 h
2	1. Li-Hydroxide 2. Ba-Acetate	12.33	23 h 44h
3	1. Li-Carbonate 2. Ba-Silicate	11.74	23 h 44h
4	Belcor 575	1.96	5 min.
5	Belcor 575 (Temperature was raised to 100° C)	1.97	1 h
6	Belcor 575 + Li-Hydroxide	11.6	10 min.
7	Belcor 575 + Li-Hydroxide (After ultrasonic cleaning)	11.6	10 min.
8	Belcor 575 + Li-Hydroxide (Section)	11.6	10 min.
9	Belcor 575 + Li-Hydroxide (After exposure in NaCl solution 40 hrs.)	11.5	120 h



**ATTACHMENT III OF APPENDIX B**

**SCANNING ELECTRON MICROSCOPY (SEM) PHOTOS**

**ON SURFACE ANALYSES**



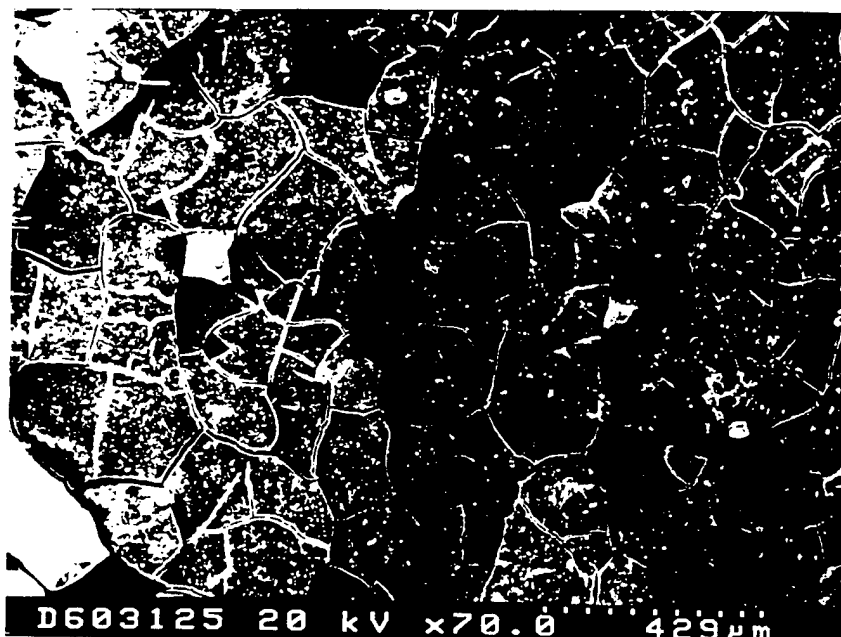


Figure 1. Carbozinc 11 pigment base was painted on the surface of Aluminum alloy Al6061. After drying, cracks can be seen under the microscope.

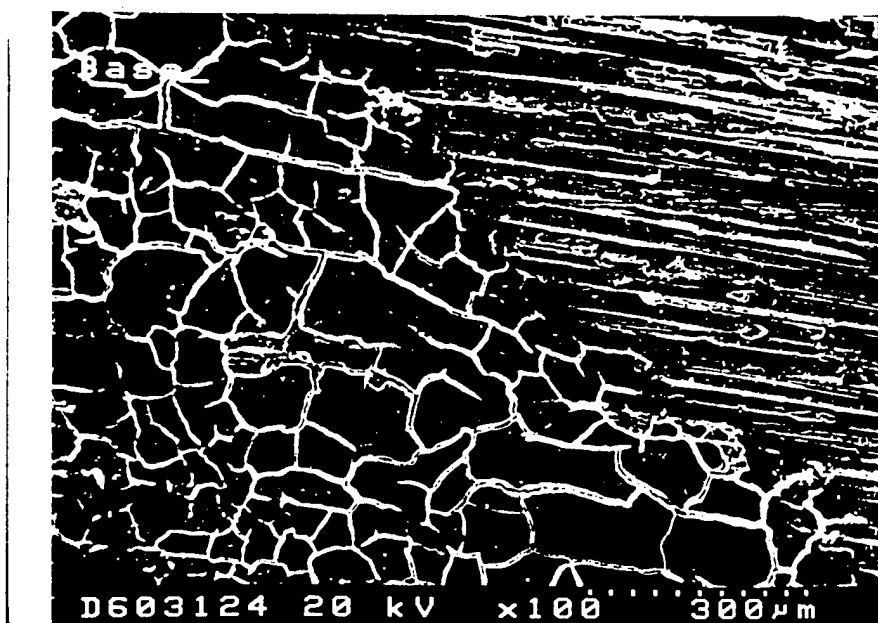


Figure 2. Carbozinc 11 pigment base was painted on the surface of Aluminum alloy Al6061. After drying, cracks can be seen under the microscope.



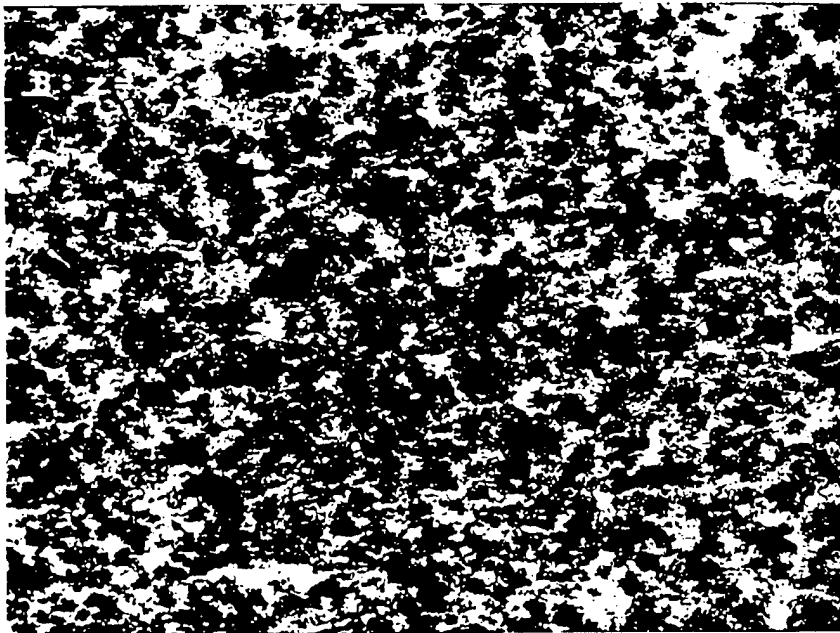


Figure 3. Carbozinc 11 pigment base was mixed with Zinc powder with the ratio 3:2 by weight. The microscope photo shows no cracks.

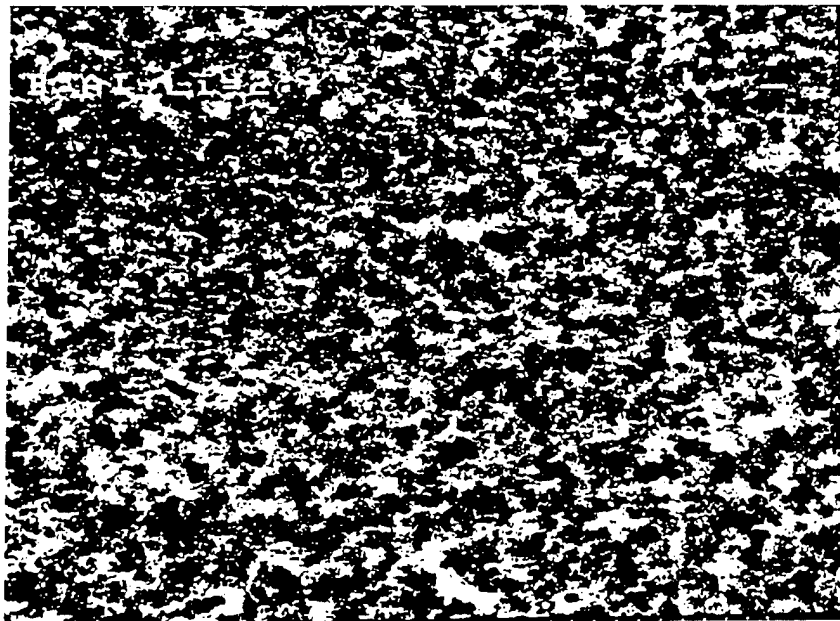


Figure 4. Carbozinc 11 pigment base was mixed with Aluminum-Lithium powder with the ratio 3:2 by weight. The microscope photo shows no cracks.



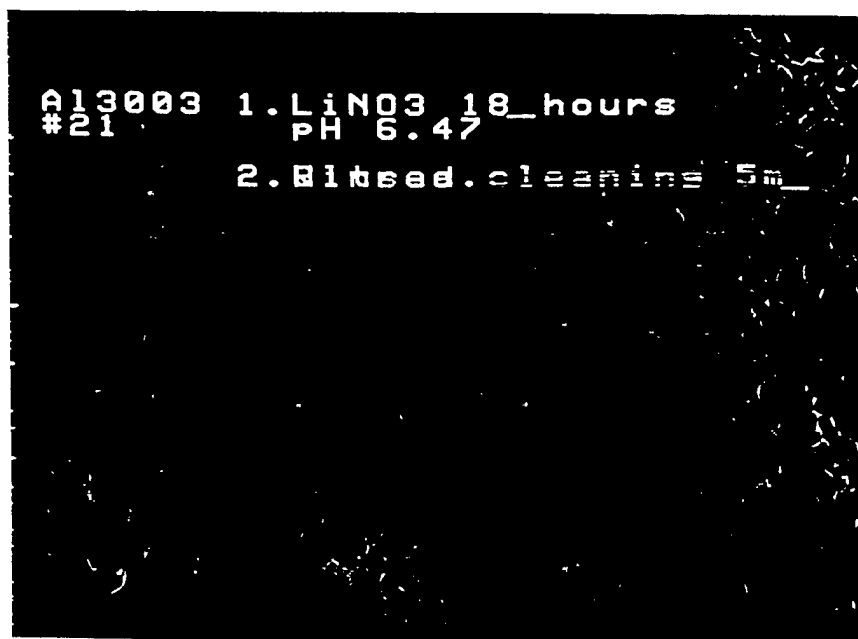


Figure 5. The surface of Aluminum alloy Al 3003, sample #21, was treated by  $\text{LiNO}_3$  solution 18 Hours with pH 6.47 and then rinsed 5 minutes with water.

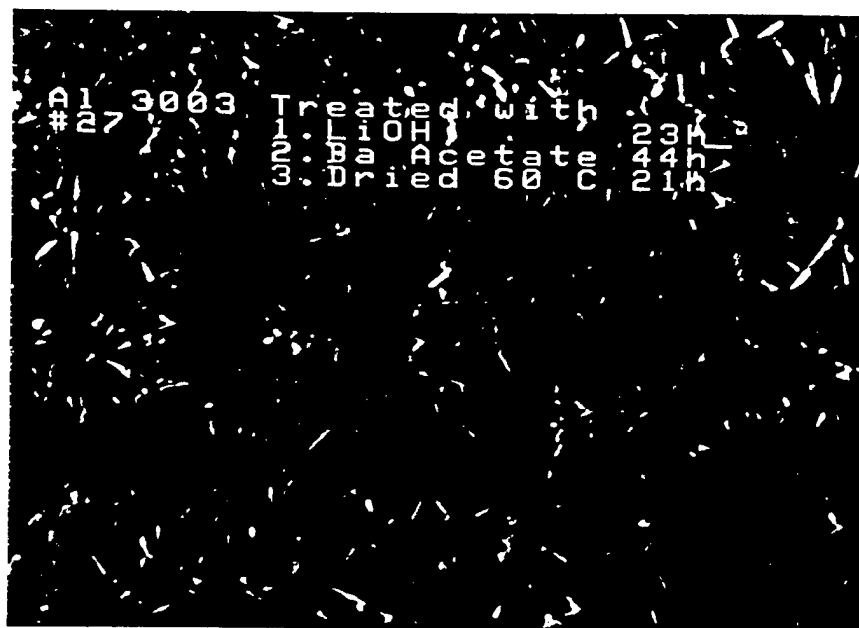


Figure 6. Modified Lithium Aluminate crystals grow on the surface of Aluminum alloy Al 3003, sample #21, which was treated with LiOH solution 23 hours, Barium Acetate 44 hours and dried at  $60^\circ\text{C}$  21 hours. The  $\text{Ba}^{++}$  modified crystals are seen to be thicker and denser.



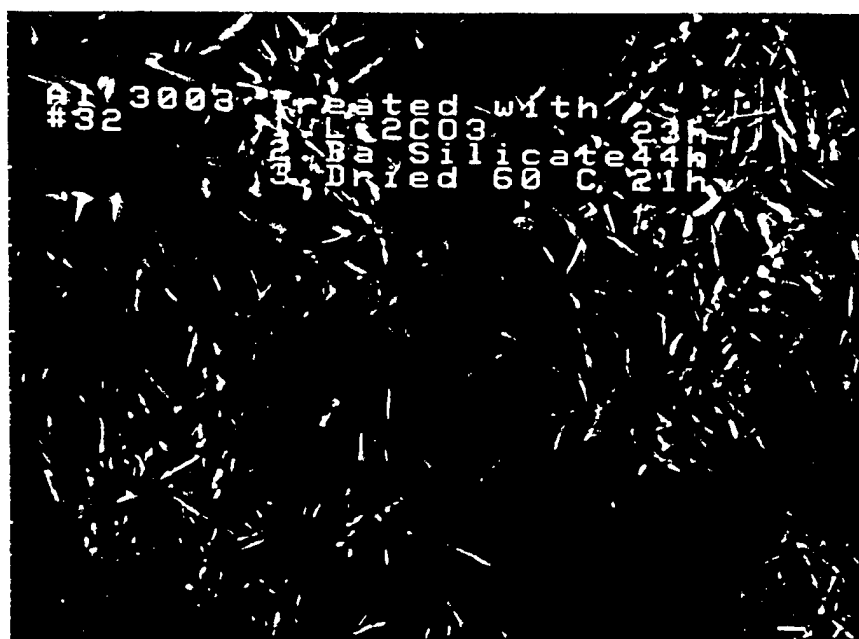


Figure 7. Modified Lithium Aluminate crystals grow on the surface of Aluminum alloy Al 3003, sample #32, which was treated with  $\text{Li}_2\text{CO}_3$  solution 23 hours, Barium Silicate 44 hours and dried at  $60^\circ\text{C}$  21 hours. The  $\text{Ba}^{++}$  modified crystals are seen to be thicker and denser.

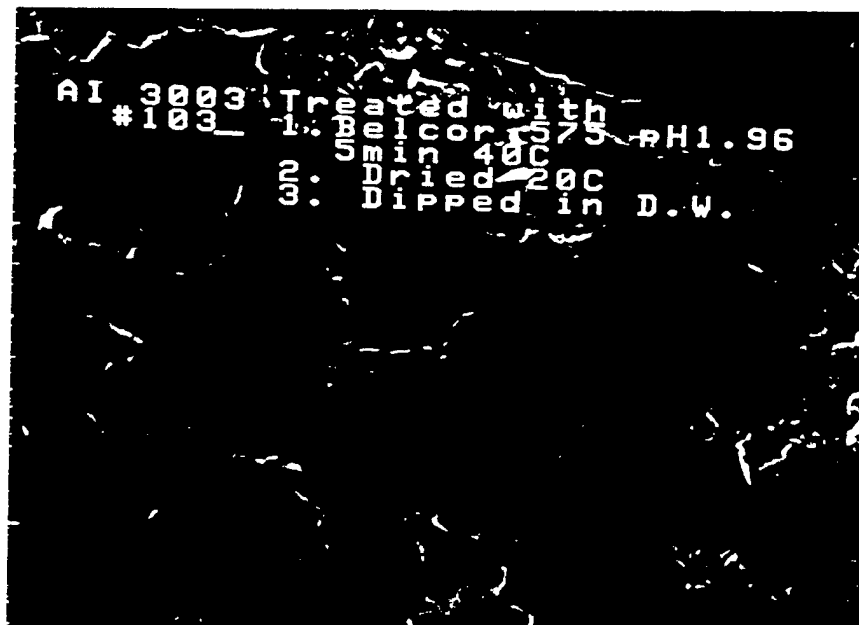


Figure 8. Treatment of Alloy Al3003 with POCA ( $\text{pH}=1.96$ ) led to slight corrosion of the alloy.



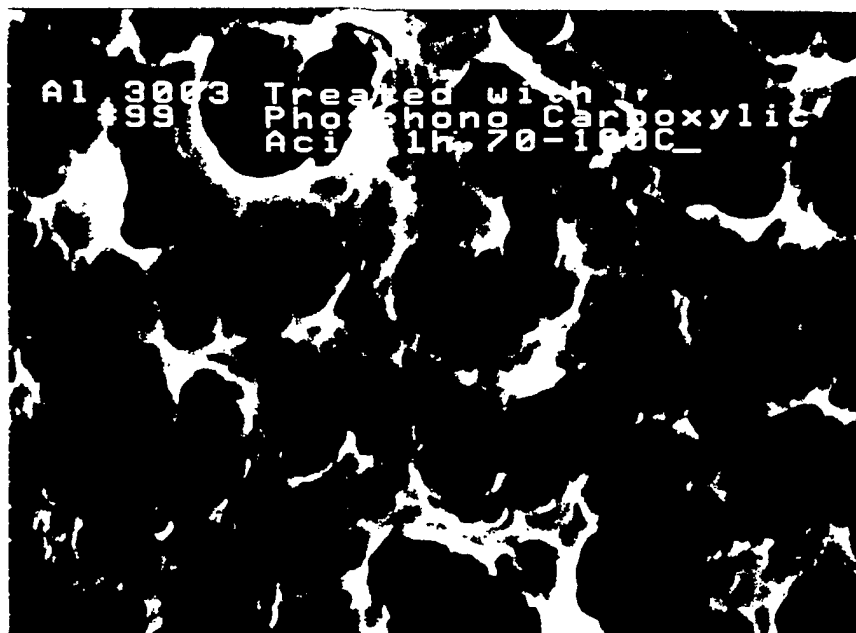


Figure 9. Corrosion was enhanced when the temperature of the electrolyte, Belcor 575, was raised.

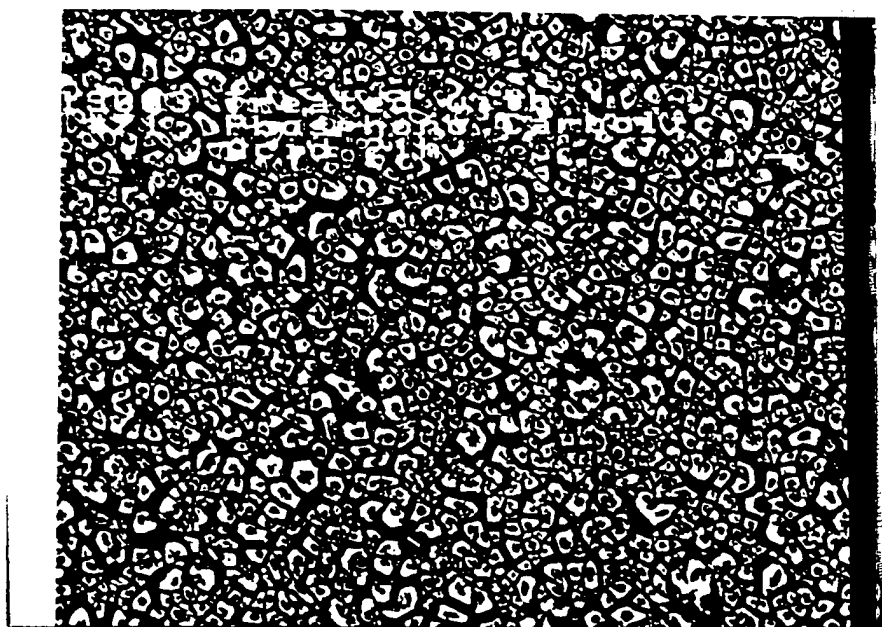


Figure 10. Treatment of the same alloy with the Li containing POCA at a higher pH (11.6) led to the formation of adherent deposits on the alloy surface.



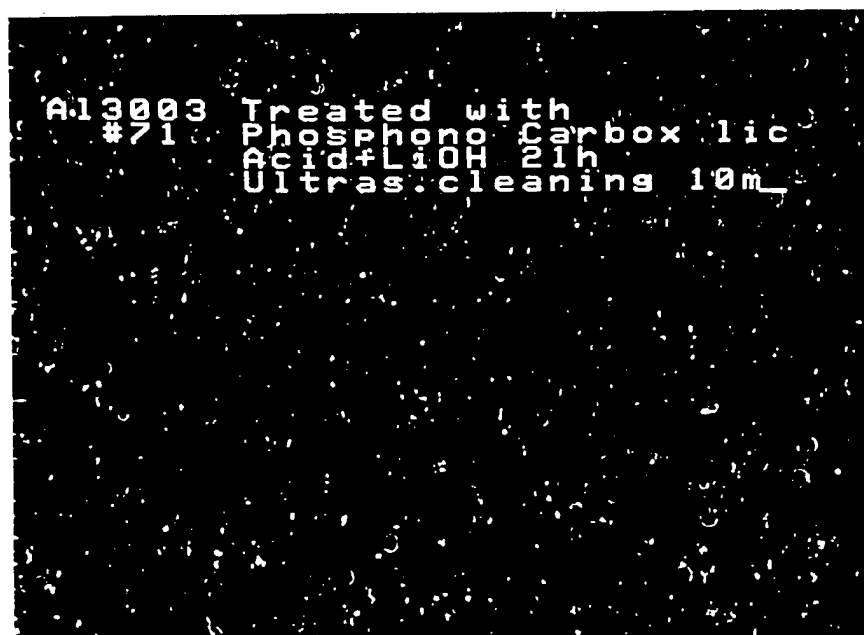


Figure 11. Vigorous ultrasonic cleaning was found to break off the deposits at their points of attachments on the alloy substrate.

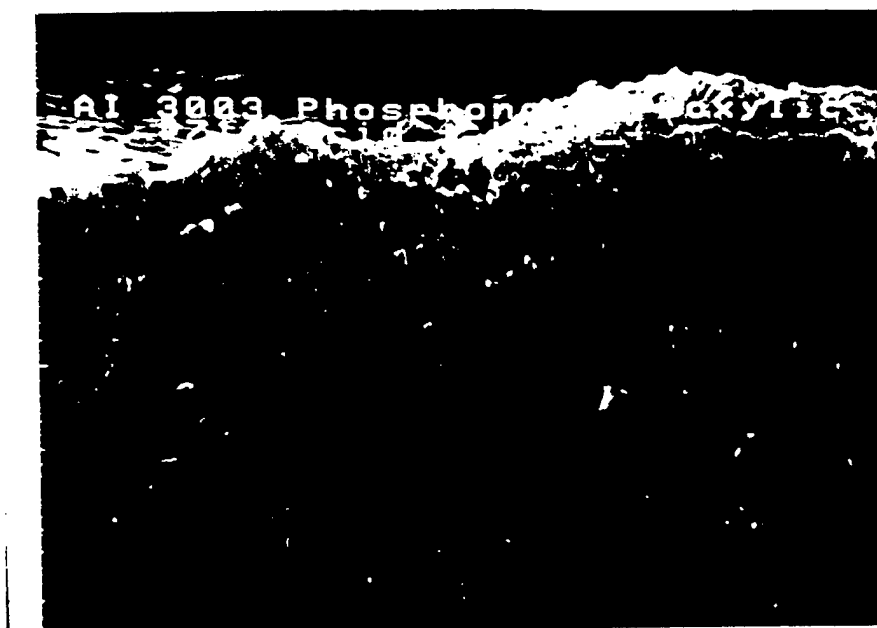


Figure 12. A cross-section of the deposit layer.



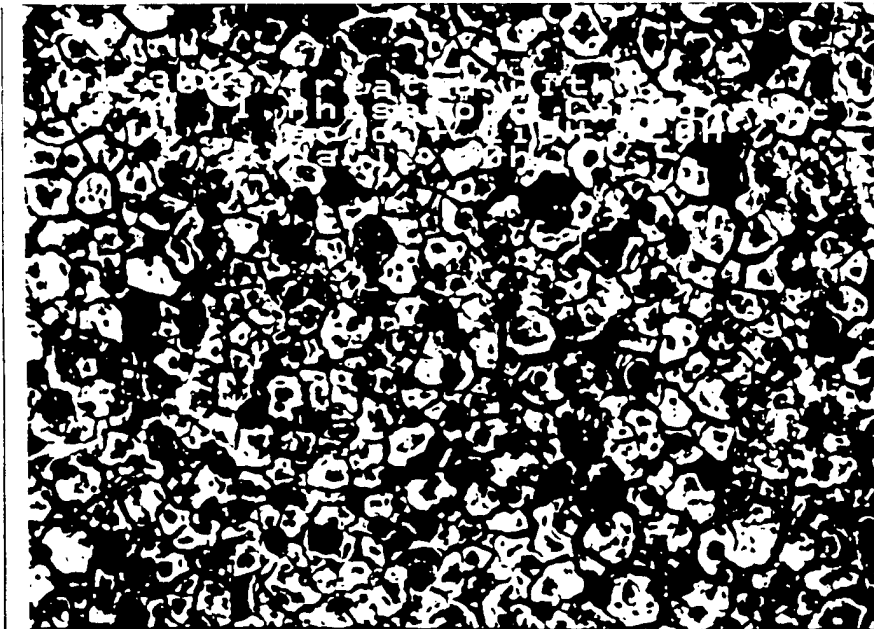


Figure 13. The coating formed with Phosphono Polycarboxylic Acid remained unattacked and is thus resistant to corrosion.



**GCRMTC PROJECT #1 DAECH PHASE II**

Schedule		Status		January				February				March				April				May				June				July				August				September				October				November				December			
		Start	Finish	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								
OBTAIN VEHICLES	1/96	6/96																																																	
	1/96	3/96																																																	
TEST VEHICLES/PIGMENT COMBINATIONS	3/96	7/96																																																	
	3/96	5/96																																																	
LAB TESTS OF SELECTED PAINTS	3/96	11/96																																																	
	5/96	11/96																																																	
PHYSICAL TESTS OF PAINT	7/96	12/96																																																	
	8/96	7/96																																																	
FIELD TEST OF PAINT	11/96	12/96																																																	
	7/96	11/96																																																	
MANUFACTURING METHODS	11/96	12/96																																																	
	7/96	11/96																																																	
REFORMULATE	3/96	11/96																																																	
	3/96	10/96																																																	
CONTINUING PIGMENTS TEST	1/96	11/96																																																	
	1/96	8/96																																																	
ARGON OVEN	10/96	12/96																																																	
	1/96	8/96																																																	
SURFACE ANALYSES	3/96	12/96																																																	
	3/96	9/96																																																	
REPORTS	4/96	10/96																																																	
	4/96	10/96																																																	
FINAL REPORT	12/96	12/96																																																	
	12/96	12/96																																																	



# **APPENDIX C**

## **INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR SHIPBUILDING FACILITIES**

**GCRMTC PROJECT NO. AMTC95-008A**

**Principal Investigator: Bhaskar Kura**  
Department of Civil & Environmental Engineering

**Additional Investigators:**

**Matthew Tarr**  
Department of Chemistry

**Yiangyang Yang, Shing Lee, and Xiao-Rong Li**  
Department of Electrical Engineering

**University of New Orleans**  
New Orleans, LA 70148



The detection is based on the type of spectrum observed which is due to the molecular vibrations of the compounds present in the air. The spectrometer measures the path integrated concentration of the pollutant along the entire length of the IR (infrared) path. This method of air monitoring will be tested at Avondale to measure organic compounds.

- Dr. Isiah Warner of the Chemistry Department of Louisiana State University (LSU) was kind enough to loan the FTIR equipment to UNO for few months. FTIR equipment was brought to UNO and is being tested in the lab and in the field. Organic compounds relevant to shipbuilding industry were reviewed to see if the instrument and instrument library supports the measurement of these compounds.
- Ambient air samples were collected using Summa canisters to analyze 43 organic compounds using Environmental Protection Agency (EPA) Method TO14.
- Ambient PM10 and PM2.5 were measured using the portable equipment.

#### **Wastewater**

- Available wastewater quality data was obtained from Avondale shipyard.
- Potential wastewater sampling locations were identified. Wastewater outfalls that are currently regulated at the Avondale Shipyard were identified for sampling. A wastewater treatment plant was visited to identify the monitoring requirements to evaluate efficiencies of sedimentation tanks, oil-water separators, biological reactors.
- Wastewater parameters that need to be analyzed were finalized. These include biochemical oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC), total suspended solids (TSS), oil & grease (O&G) and few others.
- A survey was conducted to find out a suitable laboratory that can analyze Avondale wastewater samples. Additional information was requested from different laboratories about their qualifications and the pricing for various parameters.

#### **Task 4A: Feasibility - Air & Water Quality Monitors**

- A literature search was conducted on chemical detection using spectroscopic techniques. The Hanby method was studied in detail. Preparations were made to conduct preliminary experiment using a high resolution monochromator in our optical laboratory.

#### **Task 5: Review of Existing Waste Management Techniques**

- Under this task, selective shipyards will be contacted to understand and evaluate the current waste management practices. In the first year, Avondale was studied for this type of information. Letters were sent out seeking the participation of different shipyards.



- Avondale data that was collected in the first year was reviewed to prepare a consolidated survey sheet. The survey questionnaire is being reviewed. The purpose of this survey is to contact selective shipyards in the country to obtain information on processes, materials used, waste quantities generated, costs incurred, local environmental regulations, and the current waste handling procedures. This questionnaire will be ready to send out in the first week of October 1996.
- Waste management practices in other types of industries were also briefly reviewed. Marathon Oil Refinery in Garyville, Louisiana was visited to understand the waste management practices. Marathon will be visited again to collect additional information with regard to environmental management systems.

**Task 6: Waste Minimization Through Source Reduction**

- The purpose of this activity is to identify various cleaner technology alternatives which offer source reduction or recycling methods to eliminate or significantly reduce the amount of wastes released to the environment. Documents published by EPA were reviewed for two specific processes, organic coatings and metal finishing. Various alternatives available are being evaluated for shipyard application.
- Cleaner Technologies for Organic Coatings - These include available technologies and emerging technologies. Available technologies include high solid coatings, powder coatings, waterborne coatings, electrodeposition, UV/EB radiation-cured coatings. Emerging technologies include vapor injection cure coatings, supercritical carbon dioxide as solvent, radiation-induced thermally-cured coatings. These technologies will be reviewed for potential applications in shipyard environments.
- Cleaner Technologies for Metal Finishing - Available technologies for this operation include non-cyanide copper plating, non-cyanide metal stripping, physical vapor deposition, metal spray coating etc. There are a few emerging technologies that offer reduced waste emissions to the environment. These technologies will be evaluated for possible applications in shipyards.

**PROPOSED ACTIVITIES NEXT PERIOD:**

1. Continue with air quality and wastewater quality monitoring. Investigate the need for solid waste characterization, particularly for used abrasives. Review other tasks due in waste characterization.
2. Coordinate with Drs. Yang, Lee and Li on the feasibility of developing air and water quality analyzers. Initiate lab experiments to investigate a practical approach for development of on-site monitoring techniques.



3. Finalize the questionnaire and send them to selective shipyards. Follow up with the shipyard personnel to complete the activity.
4. Review and evaluate the cleaner technologies available for other shipyard processes.

<b>COLLABORATIVE EFFORTS:</b> (2nd year: July 96- June 97)	<b>THIS QTR</b>	<b>YTD</b>
<b>\$ VALUES OF SERVICES FROM INDUSTRY:</b>		
IN KIND SERVICES:	3,750 <sup>a</sup>	3,750
ACTUAL FUNDS:		
<b>\$ VALUES OF SERVICES FROM GOVERNMENT:</b>		
IN KIND SERVICES:	11,000 <sup>b</sup>	11,000
ACTUAL FUNDS:		
<b>No. OF SIGNIFICANT CONTACTS:</b>		
INDUSTRY:	0	0
ACADEMIC:	0	0
GOVERNMENT:	1 <sup>c</sup>	1

**COMMENTS:**

<sup>a</sup> Includes the cost of Avondale staff time during field visits, providing information, assisting during field measurements etc. A total of \$3,750 accounted toward quarter man-month time of Avondale personnel.

<sup>b</sup> Dr. Isiah Warner of Louisiana State University and Dr. Matthew Tarr of University of New Orleans have spent their time during my visit to LSU, Baton Rouge. Estimated value of their time is \$ 6,000. Also, the equipment was loaned to UNO for a few months. This is estimated at \$ 5,000.

<sup>c</sup> Significant contacts made this quarter in government category are:

Ms. Susan Childress  
Enforcement and Compliance Section  
Environmental Protection Agency







# **APPENDIX D**

## **UNO-SWIFTSHIPS DEVELOPMENT OF A COST EFFECTIVE ALUMINUM CATAMARAN STRUCTURE**

**GCRMTC PROJECT No. AMTC95-010A**

**Principal Investigator: Robert Latorre**  
**Naval Architecture and Marine Engineering**

**Additional Researcher: Paul Herrington**  
**Department of Mechanical Engineering**

**Additional Researcher: Michael Folse**  
**Department of Civil and Environmental Engineering**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** Currently, US shipbuilders are not competitive in the worldwide high-speed passenger ferry market, while shipbuilders in many foreign countries have advanced the design of high speed catamarans to the point that they are marketing these craft worldwide. This project addresses the problem of developing a high speed catamaran design for the US and worldwide passenger ferry market. It is focused on improving the productivity of US shipyards by addressing the integration of catamaran design and manufacture through the research and development of an aluminum structural extrusion that will reduce the number of components, the welding required, and result in a lightweight high performance vessel.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$186,517

FUNDS REMAINING: \$ 48,600

**ACCOMPLISHMENTS THIS PERIOD:**

Task I – Market overview using CATSSD database and shipyard input determined the following market niche data based on the database results and shipyard input:

- Discussions with shipyard on catamaran market, design, and build for 1997.

Task II – Preliminary design of hull structure based on design-rule specified hull loads.

- Finite element analysis of fixed and floating frames completed one month ahead of the revised schedule.
- Failure modes of stiffeners have been clarified
- High stress regions of panel have been identified.
- Conducted tow tank model tests. (Resistance and seakeeping tests.)

Task III – Development of rational catamaran plate structure using standardized aluminum extrusion(s) to minimize ship production costs.

- Structural test panel delivered to UNO for analysis and testing.
- Modification of hull structure design in progress.
- Participated in the ANSYS seminar at Engineering Methods, Inc.
- Optimization of hull panel began with refined model.



Task IV – A final design for production will be undertaken.

- Final design for production is being continually updated.

Task V – Travel to shipyards/technical conferences to present results.

- Several trips to Swiftships, Inc. were made to support project goals.
- Paper entitled, Development of A Production Optimization Program for Design and Manufacture of Aluminum Hull Panel, in preparation for 1997 Ship Production Symposium.

#### **PROPOSED ACTIVITIES NEXT PERIOD:**

Task I – Market overview using CATSSD data base and shipyard input:

- Continue discussions with shipyard partner concerning market opportunities.

Task II – Preliminary design of hull structure based on design-rule specified hull loads.

- Complete optimization studies on aluminum hull panel. The extended time require for completion of this task is due to additional modeling requirements from variations in the preliminary design and the as-built version of the hull panel.
- Tow tank model tests will be completed next quarter. The delay in completion of this task is due to unexpected scheduling difficulties in the towing tank.

Task III– Development of catamaran structure design using standardized aluminum extrusion(s) to minimize ship production costs.

- Instrument hull panel for test.
- Experimental test of hull panel.
- Analysis of test data.
- Correlation of experimental test and finite element results.

Task V – Travel to shipyards/technical conferences to present results

- Update meetings with shipyards are planned.
- Workshop planned in December to present results.



**COLLABORATIVE EFFORTS:****THIS QTR   YTD****DOLLAR VALUES OF SERVICES FROM INDUSTRY:**

IN KIND SERVICES:	\$2,000	\$51,000
ACTUAL FUNDS:		

**DOLLAR VALUES OF SERVICES FROM GOVERNMENT:**

IN KIND SERVICES:	-	-
ACTUAL FUNDS:		

**NUMBER OF SIGNIFICANT CONTACTS:**

INDUSTRY:	3	16
ACADEMIC:	-	-
GOVERNMENT:	-	-

**COMMENTS:****DOLLAR VALUES OF SERVICES FROM INDUSTRY:**

Swiftships, Inc., has agreed to materially participate in this project by contributing the following:

- Participate in the catamaran structure design/analysis. (Estimated cost = \$7,000)
- Participate in the aluminum floating frame design. (Estimated cost = \$4,000)
- Materials and manufacture of floating frame. (Estimated cost of materials and labor = \$40,000)

**NUMBER OF SIGNIFICANT CONTACTS:**

Additional industry contacts were made as a result of continuing participation with the principal industrial collaborator, Swiftships, Inc. Contacts made this quarter include Rick Jeffs of Engineering Methods, Al Dodson of Swiftships, and representatives of Aluminum & Stainless, Inc., suppliers of marine specialty extrusions.



### **Proposed Timeline**

D-5



# **APPENDIX E**

## **APPLICATIONS OF INTEGRATED OPTICAL FIBER SENSOR SYSTEMS IN SHIPBUILDING AND SHIPBOARD MONITORING**

**GCRMTC PROJECT NO. ATMC95-014A**

**Principal Investigator: Shing Lee**  
**Department of Electrical Engineering**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** Fiber-optic-sensor systems are compact, sensitive, and can be multiplexed throughout a ship to provide hazard warning, pollution and processing monitoring, etc. This project is to investigate the applicability of shipboard monitoring using such systems. A novel fiber-optic-sensor system has been developed based on in-line photopolarimetric measurements. The performance and cost issues have been addressed. The second phase of this project is to improve the existing sensors and to address the issues of sensor multiplexing on a large scale. In particular, fiber-Bragg-grating systems will be investigated.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$85,135

FUNDS REMAINING: \$36,500

**ACCOMPLISHMENTS THIS PERIOD:**

**Task I -- Improve Phase I Sensors**

A graphical computer interface was added to the home-made in-line photopolarimeter to fully automate its operation. The results were presented at the SPIE annual conference in Denver, CO, August 1996.

**Task II -- New Sensor Redesign**

This task has been completed. Partial results were presented at the 1996 SPIE annual conference.

**Task III -- Obtaining Equipment and Technologies to Build New Sensors**

Two additional pieces of equipment, i.e., a monochromator and a fusion splicer, have been ordered in anticipation of the field tests. The bulk of the funds for this equipment comes from our Engineering college, Electrical Engineering Department, and industrial collaborators. The equipment is scheduled to arrive in the middle of October 1996.

**Task IV -- Prototype Fabrication and Test**

ESDD pollution sensors were refined and networked together to monitor insulator pollution from insulators around an Entergy substation. A randomly polarized source was devised to provide measurement stabilities in a networked environment.

A large-scale wavelength-division multiplexing fiber-Bragg-grating network was successfully demonstrated, in collaboration with researchers in the Naval Research Laboratory. The network



can monitor dynamic strains up to 700 Hz and multiplexed into hundreds of sensors without degrading its scanning speed.

A large-scale time-division-multiplexing fiber-Bragg-grating network was also demonstrated using low-reflection gratings and a high-pulse-height ASE source. The system can interrogate as many as forty-five FBG sensors in a single string of fiber.

A scanning narrow band ASE source was demonstrated using a narrow bandwidth grating as the wavelength-selective feedback mirror. This configuration costs about one third of a previously demonstrated system and is very useful for sensor applications. The results were presented in the ICCE-3 conference in New Orleans, July 1996.

#### **Task V -- Field Integration and Test**

The ESDD pollution sensor network is ready for field test. Arrangements are being made with Entergy to test the sensor network in harsh environments in a power substation.

#### **PROPOSED ACTIVITIES NEXT PERIOD:**

- (i) Fiber-grating temperature and pressure sensors will be fabricated by mounting fiber-Bragg-gratings on different substrates.
- (ii) Collaborate with Entergy to field test the insulator pollution sensors.
- (iii) Continue to work with Ingalls shipyards and Omni Corp. for testing fiber sensors on ships.

#### **COLLABORATIVE EFFORTS:**

**THIS QTR**

**YTD**

#### **\$ VALUES OF SERVICES FROM INDUSTRY INKIND SERVICES:**

None

#### **ACTUAL FUNDS:**

A collaborative effort with Entergy in  
developing evanescent pollution sensors

\$60,500

#### **\$VALUES OF SERVICES FROM GOVERNMENT: IN KIND SERVICES:**

Fiber-Bragg-gratings

\$5,000

\$15,000

#### **ACTUAL FUNDS:**

None

#### **# OF SIGNIFICANT CONTACTS:**

#### **INDUSTRY:**

3M, Lasiris, Electro TEK, Innovative Fiber, Newport



ACADEMIC:  
GOVERNMENT:

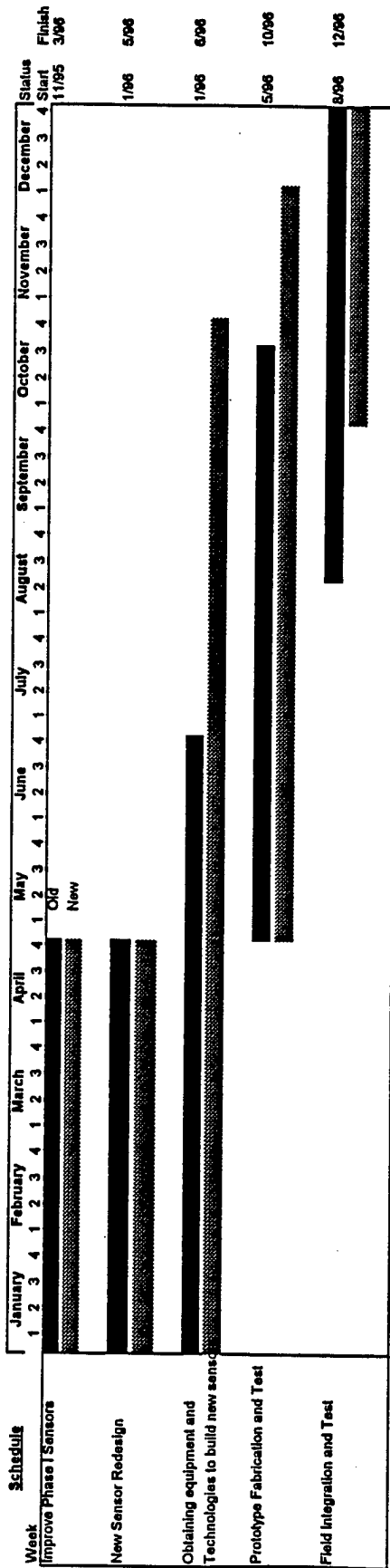
Dr. Allen Kersey, Naval Research Lab.

**COMMENTS:**

Dr. Lee recently conducted research in the Naval Research Laboratories (NRL), working with Dr. Kersey. A number of our ideas in fiber-Bragg-grating interrogation techniques were successfully demonstrated.



# **Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring (Phase II)**





# **APPENDIX F**

## **RESEARCH IN SHIPBOARD SENSORS**

**GCRMTC PROJECT NO. AMTC95-016A**

**Principal Investigator: Dr. Russell E. Trahan, Jr.**  
**Department of Electrical Engineering**

**University Of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** This project is a continuation of "Project 16 - Shipboard Sensors," begun in 1995. The main thrust of this project is to develop fiber optics based environmental sensors for shipboard use.

The tasks to be completed in the second phase of this project are

*Task 1: Comparison Testing.*

*Task 2: Repackaging.*

*Task 3: Identify Vessels for Testing.*

*Task 4: Install Prototype System.*

*Task 5: Prototype System Evaluation.*

*Task 6: Progress and Final Reports.*

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$228,476

FUNDS REMAINING: \$114,740

**ACCOMPLISHMENTS THIS PERIOD:**

Activities associated with Task 1 of Phase II and completion of Phase I:

Commercial shipboard electrical sensors for temperature and smoke in addition to an electronic sensor system processor have been received from SOTec. System integration has been started and comparison tests will follow.

Receipt of the Securiplex DDG-51 type damage control sensors is awaiting technical performance information, which must be reviewed prior to procurement of the appropriate devices. Securiplex has informed their local representative (SOTec) that the technical information is considered proprietary to NAVSEA and without written NAVSEA authorization they will neither release the technical specifications nor accept an order for the devices.

Gems flooding switches used in both commercial and military shipboard applications have been evaluated.



#### Activities associated with Task 2:

Testing continues on the new temperature sensor in the environmental chamber at two optical wavelengths. Late delivery of an appropriate semiconductor laser for the second wavelength delayed the testing schedule.

Smoke sensor final assembly is awaiting the delivery of a screen mesh cover. The drawing for the cover has been given to the machinist in the College of Sciences for fabrication.

Efforts continue to design the software interface for the fiber optic flame sensor and establish a test plan for the flame sensor performance evaluation.

#### Activities associated with Task 3:

Continuing discussion with Ingalls Shipbuilding regarding the installation of the current fiber optic prototype sensor suite within a compartment aboard a Navy ship this year. USS ROSS, DDG-71 is the planned ship.

Dialogue continues with a "Smartship" proposal team regarding the possibility of placing an upgraded fiber optic damage control system aboard this ship for evaluation next year.

Located previous NRL/UNO/Omicron Telecommunications sensors that were installed aboard the Shadwell in Mobile, AL. Devices can be assigned to UNO for evaluation if NAVSEA approves property transfer.

#### Activities associated with Task 4:

During the next quarter, after a ship is identified on which the sensors may be used, the system will be installed and testing will be initiated.

### **PROPOSED ACTIVITIES NEXT PERIOD:**

#### Activities associated with Task 1:

Receipt of Securiplex electrical flame, smoke, and temperature sensors for comparison testing.

Completion of commercial electrical sensor characterizations and comparison tests.

#### Activities associated with Task 2:

Completion of fiber optic temperature sensor evaluation and system interface.



Activities associated with Task 3:

Continue discussions with Ingalls about upgrades to packaging required for ship installation and testing.

Continue "Smartship" dialogue.

Activities associated with Task 4:

Install sensors aboard USS ROSS, DDG-71.

Activities associated with Task 5:

Begin collecting data on shipboard system.

Activities associated with Task 6:

Write Final Report.

**COLLABORATIVE EFFORTS:**

**THIS QTR**

**YTD**

**\$ VALUES OF SERVICES FROM INDUSTRY:**

**IN KIND SERVICES:**

**\$10,500**

**\$38,542**

**ACTUAL FUNDS:**

**0**

**\$ VALUES OF SERVICES FROM GOVERNMENT:**

**IN KIND SERVICES:**

**\$500**

**ACTUAL FUNDS:**

**0**

**NUMBER OF SIGNIFICANT CONTACTS:**

**INDUSTRY:** Dr. Emory Moore, Litton FiberCom  
Perry Hayman, Ingalls Shipbuilding  
Jimmy Hatzoglidis, Securiplex  
Mark Ippolito, SOTEC

**ACADEMIC:** Dr. Shing Lee, Department of Electrical Engineering, UNO

**GOVERNMENT:** Mr. Steve Gibson, NRL Stennis



Mr. Grant Bauer, NRL Director Stennis

**COMMENTS:**

Our contacts at Ingalls have secured a place on a US Navy ship (DDG-71) for installation of the system by the end of October/early November timeframe. This will leave the month of November and December to complete the prototype system evaluation. Some sea trials may extend into calendar year 1997 and monitoring of the system may also have to continue. Furthermore, some discussion has occurred regarding the placement of these sensors aboard the DD vessel designated as the composite mast evaluation ship. Discussions continue about "Smartship" involvement. The Stennis NRL office has the existing UNO/Omicron sensors developed in 1992 and efforts are underway to reassign them back to the University of New Orleans under a property transfer.

The month of December will be used for the writing of the Final Report which will include whatever shipboard data has been collected prior to year's end.



# Shipboard Sensors (Phase II)

Schedule	Week	January				February				March				April				May				June				July				August				September				October				November				December				Status	
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	Start	Finish								
Comparison Testing																																												1/96							
Repackaging																																												1/96							
Identify Vessels for Testing																																												2/96	7/96						
Install Prototype System																																												7/96							
Prototype System Evaluation																																												9/96							
Progress and Final Reports																																												11/96							

Updated September 26, 1996  
Original Schedule  
Modified Schedule



# **APPENDIX G**

## **RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM) DATABASE / SHIPNET OF SHIP OPERATIONS COOPERATIVE PROGRAM (SOCP)**

**GCRMTC PROJECT NO. AMTC95-018A**

**Principal Investigator: Bahadir Inozu**  
**School of Naval Architecture and Marine Engineering**

**Additional Researchers:**

**Philippe Roy**  
**Veronique Molinari**  
**Scott Young**  
**Iskender Gursoy**  
**Ivan Radovic**  
**Axel Stang Lund**  
**Torstein Reinersten**  
**Dwi Priyanta**  
**Juan Manero**

**School of Naval Architecture and Marine Engineering**

**Linxiong Li**  
**Mathematics Department**

**Ward Edwards**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** Set up & populate the integrated RAM Database of Ship Operations Cooperative Program (SOCP) and establish & activate the data exchange network SHIPNET. The overall objective of this project is to provide marine industry with robust equipment performance data to improve total life cycle of ships in terms of safety, reliability, cost-effectiveness and overall quality. SHIPNET is a computer based system of RAM data collection, evaluation and dissemination. This consists of a network of integrated RAM databases connected to the master database located at GCRMTC. SHIPNET has been formed to facilitate the efficient collection, analysis, and sharing of vessel life cycle data and to promote consensus building activities in the maritime industry.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$406,000

FUNDS REMAINING: \$161,921

**ACCOMPLISHMENTS THIS PERIOD:**

**TASK I - DATE & SHIPPER Development / Test and Modifications**

Accomplishments July-September 96

Specifications for the new version of DATE and SHIPPER were developed based on the implementation workshop results and sent to Diversified Computer Consultants (DCC) in early July. SOCP requested a few additional modifications in early August.

The new version of DATE was delivered on July 25, 1996. These upgraded versions of DATE and SHIPPER which include the additional modifications requested by SOCP were delivered on September 9, 1996. DCC delivered installation disks of the Beta version on September 16, 1996. These disks were forwarded to the LNG Taurus, a liquid natural gas carrier, for on board testing. DATE and SHIPPER Version 2.1 beta are currently under testing both at UNO and on board LNG Taurus.

**TASK II - SPIN and SHIPS' RAM Development**

Accomplishments July-September 96

SHIPS' RAM hardware specifications have been determined. SHIPS' RAM database will be stored on a Sun SPARC Server 20 whereas the powerbuilder front end will be on a PC. Connection between the Sun Server and the PC will be made using 10 Based-T ports and the



TCP/IP communications protocol. The preliminary estimate for the Solaris 2.4 version of Oracle 7.1 and the communications hardware & software has been obtained.

Testing of SPIN Version 1.0 Beta has been continuing. Specifications for SPIN upgrade to comply with the new version of DATE are under development.

### **Task III - DATE Interfaces**

#### **Accomplishments July-September 96**

Interface program specifications for Sea-Land Electronic Voyage Abstract (EVA) have been developed and sent to DCC whose programmers are also analyzing the database structures of the Marine Management Systems (MMS) Fleetworks and Voyage Report System (VRS) to design DATE interfaces. Database connection protocols have been examined for both programs.

Ship Breakdown Structure and Ship Life Cycle Modeling studies have been initiated in cooperation with the United States Coast Guard for the MSTEP (Marine Safety Evaluation Program) Interface.

A special meeting was held at ABS Americas in Houston for Rules 2000 and SAFENET interface needs on September 26, 1996.

### **Task IV - Population of RAM Database**

#### **Accomplishments July-September 96**

Energy Transportation Group (ETG) provided the machinery maintenance history files of its entire fleet in electronic format for the 1990-1996 period. Transfer of these data into DATE format will require the help of chief engineers to identify some mandatory fields of DATE.

### **Task V - Analysis of RAM Data**

#### **Accomplishments July-September 96**

Pilot study for ETG's main condensate pumps will be completed on November 15, 1996. A special report is under preparation.

Preliminary analysis of ARCO's main boiler feed pump RAM data has been completed. Based on the results, the scope of the analysis has been expanded from seal failures to include all failures. Pump manufacturer also agreed to participate in the study and a special failure report was forwarded to the manufacturer for further analysis.



## **Task VI - Creation of SHIPNET Help Desk**

### **Accomplishments July-September 96**

SHIPNET Help Desk is now operational. DATE and SHIPPER on-line help as well as the data entry guidelines are being updated for the new Version 2.1. The new user guide is under preparation. A Web page has been prepared for the project. The address of the web site is <http://www.uno.edu/~engr/shipnet.html>.

## **Task VII - SEM Training / Strategic Planning / Build One Requirements Definitions**

### **Accomplishments July-September 96**

A joint SEM training-strategic planning workshop was held at Sea-Land headquarters in Charlotte, NC on August 19-21, 1996 with the help of Rockwell International. The SOCP executive committee decided to pursue the formation of a non-profit corporation to operate the RAM Database / SHIPNET, as well as other commercial ventures initiated under SOCP. Various implementation tasks have been identified and prioritized for the rest of 1996 and 1997. Next strategic planning session will be held at MITAGS on October 23, 1996.

## **Task VIII - International Ship Network Development - Phase IV**

### **Accomplishments July-September 96**

Contacts with various shipping organizations and classification societies have continued. The SOCP executive committee decided to respond positively to OREDA/SINTEF's offer to exchange experience on RAM database operation and organize an annual joint workshop for this purpose.

### **PROPOSED ACTIVITIES NEXT PERIOD:**

1. Finish stand-alone DATE and SHIPPER Version 2.1 Development
2. Finish selected DATE Interfaces for ARCO and Sea-Land
3. Design Training Workshop(s) on
  - SHIPNET Software Use
  - Reliability Centered Maintenance
  - Risk Based Technology
  - Standard RAM data applications
4. Finish the Pilot Study for ETG and ARCO
5. Develop the implementation structure
6. Prepare the participation agreement
7. Start developing the Business Plan
8. Prepare a Master Data Collection Plan and start data collection accordingly



9. Get Involved in Standards Development via ASTM F25 and related ISO activities

**COLLABORATIVE EFFORTS:**

**THIS QTR   YTD**

**\$ VALUES OF SERVICES FROM INDUSTRY:**

**IN KIND SERVICES:**

SOCP/ Energy Transportation Group	\$23,250	\$53,100
SOCP/Sea-Land Service Inc.	\$ 6,600	\$13,600
SOCP/ARCO Marine Inc.	\$ 9,000	\$24,750

**ACTUAL FUNDS:**

SOCP (Cont.): \$ 59,189.00 + Management

**\$ VALUES OF SERVICES FROM GOVERNMENT:**

**IN KIND SERVICES:**

**ACTUAL FUNDS:** Same as above\*. SOCP is an industry-government cooperative program.

**# OF SIGNIFICANT CONTACTS: 28**

**INDUSTRY:** P.G. Schaedel and Don McLendon (Energy Transportation Group), M. Bohlman and Lynn Rambeau (Sea-Land), F. Lee and Matthew MacDonald (ARCO Marine), R. Conachey, A.K. Seah, John Conlon, David W. Robinson and E. Reilly (ABS), G. Jones and Dr. Z. Bazari (Lloyd's Register), Egil Rensvik and Roar Henningsen (MARINTEK), Terje Sten and Helge Audun Sandtorv (SINTEF), Jon Rysst, Tor Erik Andersen, Rolf Skjong, and Terje Staalstrom (DNV).

**ACADEMIC:** Prof. Magnus Rasmussen (NTNU)

**GOVERNMENT:** J. Zok, P. Randall and John Dumbleton (MARAD), Z. J. Karaszewski, N. Lemley, Robb Wilcox (USCG - National Maritime Center).

**SCHEDULE MODIFICATIONS**

Development of company specific guidelines will continue since they require testing of DATE interfaces. Pilot study for ARCO has been expanded due to change in scope. DATE Interface deadlines have been revised due to DATE upgrades.

**COMMENTS:** None.



Reliability, Availability, Maintainability (RAM) Database / SHIPNET of SOCP - 10/18/1996

Schedule		Status																													
		Start	Finish			January		February		March		April		May		June		July		August		September		October		November		December			
		W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T	W	T
1 DATE & SHIPPER V. 2.0 Beta testing		1/1/96	8/10/96																												
2 Final Modifications of DATE & SHIPPER V. 2.0		1/1/96	8/10/96																												
2.1 Code Development		8/10/96	8/16/96																												
2.2 Testing / Revisions		8/16/96	9/16/96																												
3 Full scale DATE & SHIPPER v. 2.1 Beta testing		8/16/96	12/31/96																												
4 SPIN & SHIP's RAM softw. development		9/16/96	12/31/96																												
4.1 Code development for V. 1.0 Beta		2/1/96	5/12/96																												
4.2 Beta tests of V. 1.0 Beta		2/1/96	5/12/96																												
4.3 Modification of SPIN & SHIP's RAM		8/12/96	10/31/96																												
5 DATE Interfaces		10/31/96	12/31/96																												
5.1 Survey to examine current formats		12/1/95	4/30/96																												
5.2 VRS Interface for ARCO		12/1/95	4/30/96																												
5.2.1 Development of Interface module for VRS		8/18/96	10/31/96																												
5.2.2 Test of Interface module for VRS		8/20/96	9/5/96																												
5.3 MMS Fleetworks Interface for ARCO		10/31/96	12/31/96																												
5.3.1 Development of Interface module for MMS Fleetworks		9/5/96	10/5/96																												
5.3.2 Test of Interface module for MMS Fleetworks		9/24/96	11/15/96																												
5.4 Voyage abstract Interface for SL		8/16/96	9/30/96																												
5.4.1 Development of Interface module for EVA		11/15/96	12/31/96																												
5.5 AMOS - D Interface for SL		9/30/96	10/31/96																												
5.5.1 Development of Interface module for AMOS-D		9/24/96	10/15/96																												
5.5.2 Test of Interface module for AMOS-D		10/15/96	12/31/96																												
6 Customization of DATE		9/1/96	10/31/96																												
6.1 for ETG		4/7/96	12/31/96																												
6.2 for ARCO		4/7/96	12/31/96																												
6.3 for S / L		5/1/96	12/31/96																												



Reliability, Availability, Maintainability (RAM) Database / SHIPNET of SOCP (Cont.)

Schedule	Status		Month												New
	Start	Finish	Jan	Feb	Mar	Apr	May	June	July	August	September	October	November	December	
7 Development of Data Entry Guidelines															
7.1 General Guidelines	2/9/86	11/7/86													
7.2 Company Specific Guidelines for ETG	2/2/86	9/16/86													
7.3 Company Specific Guidelines for ARCO	4/5/86	11/16/86													
7.4 Company Specific Guidelines for SL	4/5/86	9/16/86													
8 Site visits for initial surveys															
8.1 ARCO	12/1/85	4/8/86													
8.2 S/L	12/1/85	4/8/86													
8.3 ETG	12/1/85	5/30/86													
8.4 ABS	11/1/85	5/22/86													
9 Pilot studies for RAM data analysis															
9.1 Feed Pump Pilot Study for ARCO	12/1/85	12/31/86													
9.2 Condensate pump pilot study for ETG	11/1/85	9/1/86													
10 MSTEP Interface	11/1/85	10/31/86													
10.1 Defining Roles															
11 ABS Interface-Phase I	4/12/86	12/31/86													
12 SHIPNET help desk- Phase I	4/12/86	8/21/86													
13 International Ship Network Development- Phase IV	1/30/86	12/31/86													
14 Consensus Meetings at UNO (Guidelines / MSTEP/ SHIPNET	1/30/86	12/31/86													
15 SEM Training	5/10/86	12/31/86													
16 Strategic Planning	5/10/86	12/31/86													
17 Regular RAM DB Population - Phase I	11/7/86	12/31/86													
18 Build one	11/7/86	12/31/86													



# **APPENDIX H**

## **SOFTWARE APPLICATIONS FOR SHIPBUILDING OPTIMIZATION**

**GCRMTC PROJECT NO. AMTC95-027A**

**Principal Investigator: Norman L. Whitley**  
**Department of Mechanical Engineering**

**Additional Researchers:**

**Madhov Parini**  
**Sudhakar Tallavajhula**  
**Mohammed Ibraim**  
**Pinlin Xuang**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** This proposal calls for the investigation of current shipbuilding methodology and the incorporation of computer-based procedures in shipbuilding design and manufacture.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$143,900

FUNDS REMAINING: \$ 77,028

**ACCOMPLISHMENTS THIS PERIOD:**

Accomplishments in this period are identified by task below:

**TASK 1—Improve Productivity**

- a. More graduate students were hired. Now there are 4 graduate students in the lab.
- b. Purchased hardware/software improvements for the ACLS. These were meant to make the platforms in the lab more stable and more effective. The machines, after having been in the shop for some time have behaved nearly perfectly for the last two months. This was probably helped by the upgrade of our NT server to 3.51 pack 4. Additional hard-disks were purchased for two machines which can be booted with either NT, Windows 95 or LINUX as the operating system. This will increase the flexibility of the lab and increase productivity. New C++ compilers and remote X-window connection software are being purchased. A color printer was purchased to support the printing of colored output from the CAD environment.

**TASK 2—CAS.CADE Code Generation**

Algorithms were developed to convert tables of hull offsets into sets of control points that allow a ship hull to be defined in terms of non-uniform rational b-spline (NURB) surfaces. Some emphasis is being placed on quantifying the "fairness of surfaces," which is subjective in nature. The goal is to capture some aesthetic qualities of "good hull forms" while creating hulls that are easily manufactured and hydrodynamically sound.

We have gained access to DT-NURBS, the NURBS library developed by Boeing for David Taylor. This extensive library has NURBS algorithms for many of the tasks that are needed for shipbuilding. They are written in FORTRAN but can be accessed by CASCADE.

The algorithms and structure for a preliminary or concept design tool for container ships are being implemented. This is meant to be a prototype tool that shows the power of CASCADE. Some of the algorithms are being developed using MAPLE and then are ported to the C++ environment. The Units of Functionality and the Applications Objects from the NSRP STEP Application



Protocols that were needed for these applications. These objects are being integrated into the CASCADE object hierarchy. Three graduate students are involved in this code development.

#### **TASK 3--Expert System Development.**

Mr. Pinlin Xuang has continued to work on this project and is making good progress. By moving to Windows 95 it was possible to take advantage of the Window environment and use 32 bit code. An Oracle database is being used to access information.

#### **TASK 4—Trips/Meetings/Contacts.**

Attended a meeting of the SP-4 panel in Washington, DC on July 17 and 18. At this meeting the idea of NSRP Super Projects was introduced. Of these, two were pertinent to this project. There will be a super project to advance EDI within shipbuilding. Dr. Burt Geschner of General Dynamics has taken the lead on this. Whitley has supplied him with information on which the preliminary proposal was based and will remain an active member of this project group to assure that his work is compatible with this project. The second germane super project was one on developing weld application protocol for automated planning of robotic welding. This is a project where CAD data and software will be used to streamline the welding process. It is a project where topology and not just geometry is the key. It is very much related to the object structure and database capabilities that CASCADE possesses.

At this meeting Mr. Richard Moore presented the conclusions of phase I of the UMTRI-MSD project. One pertinent conclusion of this group was that enterprise wide information sharing and manufacturing planning based on this sharing is essential to success. This is consistent with our efforts and goals.

Dr. Whitley visited Newport News Shipyard (NNS) on July 19 and met with Mr. Sam Tatum, (Program Manager, CAD/CAM Implementation, NNS) and Mr. Pat Rourke (Systems Architect, CAD/CAM Implementation, NNS). The VIVID system that NNS and Lockheed have jointly produced was reviewed. Although no formal agreement was reached for future cooperation, it is anticipated that this group will work with us as our prototype develops. They have agreed to offer guidance in areas where it is needed.

#### **PROPOSED ACTIVITIES FOR THE NEXT PERIOD:**

##### **TASK 1 -- Improve Productivity**

Some software and hardware will continue to be purchased to make our lab more flexible and more productive. This would include the loading of LINUX on machines, and adding an IOMEGA JAZ drive to the DEC ALPHASTATION.



## **TASK 2 -- CAS.CADE Code Generation**

It is anticipated that much of the class hierarchy of the prototype for the project will be completed by the end of this period. We will also be developing the methods for utilizing these class objects.

## **TASK 3 -- Expert System Development**

The Expert System development will continue. A working prototype is anticipated by the end of this period.

## **TASK 4 -- Trips/Meetings/Contacts.**

Mr. Claude Hessenet of Matra/Datavision will visit the Center October 2, 3, and 5. During that time we will receive some training, but the majority of the time will be spent working on the details of our prototype system. He will help us formalize our class hierarchy and schema. The main emphasis of these three days is to give us a boost in our development. When he leaves we expect to have a very clear idea of our class structure.

Dr. Whitley will attend the combined SP-4, SP-6, and SP-8 panel meetings in Mobile, AL. The super projects mentioned earlier will be discussed and refined.

### **COLLABORATIVE EFFORTS:**

	<b>THIS QTR</b>	<b>YTD</b>
<b>\$VALUES OF SERVICES FROM INDUSTRY:</b>		
IN-KIND SERVICES:	0	0
ACTUAL FUNDS:	0	0
<b>\$VALUES OF SERVICES FROM GOVERNMENT:</b>		
IN-KIND SERVICES:	0	0
ACTUAL FUNDS:	0	0
<b># OF SIGNIFICANT CONTACTS:</b>		
INDUSTRY:	6	18
ACADEMIC:	0	2
GOVERNMENT:	4	12

**COMMENTS:** None.



# SOFTWARE APPLICATIONS FOR SHIPBUILDING APPLICATIONS

TASKS	MONTHS											
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
EDI PROTOTYPE												
SHIP STRUCTURE CLASS												
HIERACHY												
DXF TO STEP COMPLIANT												
MODULE												
DXF TO PARAMETRIC												
MODULE			DONE									
EXPERT SYSTEM FOR												
STANDARDS MODULE												
PROJECT MANAGEMENT												
TRPS/MEETINGS/TRAINING												
REPORTS												



# **APPENDIX I**

## **IMPROVING TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY**

**GCRMTC PROJECT NO. AMTC95-030A**

**Principal Investigator: William Lannes, P.E.**  
**College of Engineering**

**Co-Principal Investigator: James Logan, Ph.D.**  
**College of Business, Department of Management**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** The purpose of this project is to develop an improved technology transfer process, incorporating change management techniques, for use in the shipbuilding industry. The deliverables from this project consist of an improved technology transfer process, incorporating industry best practices and current knowledge of organizational change into a matrix evaluation model, and its accompanying implementation protocol. The process incorporates financial, technical, and behavioral factors into a normative model designed to enhance organizational technology transfer. The model is for use by firms in the shipbuilding industry to evaluate current firm practices against best practices and to identify target areas for improvement within a firm. The improved process model identifies significant stakeholders in the technology transfer process and incorporates their needs. The model is customizable to individual firm requirements to insure maximum usability. Additional benefits of this project are the generation of a current, focused data base on the subject of technology transfer in the shipbuilding industry, and increased understanding within both the College of Business and the College of Engineering at the University of New Orleans of a very significant regional industry.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$133,492

FUNDS REMAINING: \$ 66,788

**ACCOMPLISHMENTS THIS PERIOD:**

1. **Preparation of scholarly papers.** Two scholarly papers dealing with the results of the research done under GCRMTC project 30 have been prepared. The first, an abstract prepared for presentation at the 1997 Ship Production Symposium, the Society of Naval Architects and Marine Engineers, is titled: "*A Computer-Aided Process for Assessing the Ability of Shipyards to Use Technological Innovation*". This abstract was accepted and work is progressing on the full paper that is scheduled to be delivered to the Technical Committee of the 1997 Ship Production Symposium no later than November 22, 1996.

The second paper, titled "*Innovation, Technology Transfer, and Reward Systems: A Preliminary Study of the United States Shipbuilding Industry*" is completed and was submitted to the Institute of Decision Sciences, Southwest Division, for inclusion in its annual meeting in New Orleans, LA, in March, 1997. This paper has, in addition to the primary investigators, Dr. Susan Hanlon of the University of Akron as a co-author. Dr. Hanlon is a recognized authority on compensation and reward systems in innovative organizations. This paper (*an abstract is attached*) uses some of the findings from the survey done as part of the Project 30 initial work. Work is also progressing on an additional paper utilizing the results of the survey, the initial literature review,



and more sensitive statistical methods that should provide interesting findings about technology transfer in the shipbuilding industry.

2. **Refined software system** prototype and develop initial protocol for use in shipyards. This is an ongoing development activity that incorporates changes as needed as the team works with the software system. After working with C++ as a language for the initial proof of concept software, the team decided that a commercially available software authoring package, FoxPro version 3.0 would be more effective. This product provides both software development and the ability through the licensing agreement provided with the FoxPro authoring package to distribute the finished product to interested parties in the shipbuilding industry without having to pay additional royalties for use. An important part of this project is to distribute the end product to as wide an audience in the shipbuilding industry as is possible. The software developed with the FoxPro system runs on any Windows® or Windows 95® equipped personal computer, and the user has to pay no site license or royalty fee of any sort. The team intends to distribute the software and accompanying usage protocol to interested organizations in the shipbuilding industry at the completion of this project.

In actual use, the software system is used by the various stakeholders in the innovation process. The perceptions of the stakeholders are captured through recording the answers the participants in the process give to the questions asked in the software. The answers the participants in the process give are used for two purposes. First, the answers of the respondents are compared to a set of answers that would be the norm for an innovative company. This is done through a simple additive scale that will allow an overall measure of innovative capacity and also allow evaluation of innovative capacity in several sub-areas that are components of the model. Second, the answers are compared to each other so that the degree of correlation between each of the participants can be determined. By forcing each of the participants in the innovation process to specify their perceptions about important elements of the innovation process or technical innovation being considered, potential problem areas can be identified and dealt with in a much more efficient manner, leading to an improved technology transfer process. The software displays the information both as text and in graphical format, thus facilitating comparison between stakeholders in the innovation process.

The Project 30 team has revisited the project milestone schedule and has made adjustments so that the project can still be completed on schedule. Prototype testing was extended until August 30, 1996. In addition, field implementation has been changed to October 10, 1996 (see revised time line attached). This revision was due to unforeseen problems with software development. The team thinks that it is very important to have a professionally finished product to use with the industry partners, and the software needed additional debugging time. It is believed that the problems are solved, and the additional time was used to confer with the industry partners, and line up potential new industry partners and test sites. At this time, the team is still confident the project will be finished on schedule.



3. **More sophisticated survey data analysis** has been completed for 102 usable surveys. The team has done additional content analysis on data from the open-ended questions on the survey, as well as using the CHAID® data analysis procedure to search for data patterns. This information will be incorporated into the scholarly paper currently being prepared.

#### **PROPOSED ACTIVITIES NEXT PERIOD:**

1. **Test of model and software** against past technological innovation with industry partners to determine predictive ability and refine measurement capability. Work will be carried out with industry partners to determine if the model is congruent with the technology transfer process as it occurred in past instances. If so, the team will work with industry partners and other GCRMTC projects to evaluate the model and protocol under field conditions.
2. **Change system and software** to incorporate corrections/improvements suggested by industry participants. This is the ongoing purpose behind the rest of this project and any follow on projects.
3. **Recruitment of additional (volunteer) industry participants** to test refined system and software in fourth quarter. These will be participants in GCRMTC projects as well as interested participants in the shipbuilding industry.

#### **COLLABORATIVE EFFORTS:**

##### **THIS QTR**

##### **YTD**

#### **\$VALUE OF SERVICES FROM INDUSTRY:**

**IN KIND SERVICES:**

**ACTUAL FUNDS:**

—

—

\$2000

—

#### **\$VALUE OF SERVICES FROM GOVERNMENT:**

**INKIND SERVICES:**

**ACTUAL FUNDS:**

—

—

—

—

#### **# OF SIGNIFICANT CONTACTS:**

**INDUSTRY:**

**ACADEMIC:**

**GOVERNMENT:**

4

5

0

121

12

3



**COMMENTS:**

Most contacts and in kind time contributions were made in the first year of this project. Additional industry contacts will be made in current phase of project as the system is used with industry participants.



## **ABSTRACT**

### **INNOVATION, TECHNOLOGY TRANSFER, AND REWARD SYSTEMS: A PRELIMINARY STUDY OF THE UNITED STATES SHIPBUILDING INDUSTRY**

Measures of successful technological innovation are consistently correlated with reward systems designed to reward innovative behavior and create a work climate that supports innovation. The lack of reward systems that are congruent with change and innovation are a common barrier to innovative activities, such as technology transfer, within large, traditional organizations.

The shipbuilding industry in the United States is an industry within which large, traditional firms are interested in understanding and overcoming barriers to effective innovation and successful technology transfer. A preliminary study was conducted in an effort to understand the role of innovation, technology transfer, and the potential of reward systems to facilitate planned change within the shipbuilding industry.

600 organization members that worked with innovation and technology transfer in 150 randomly chosen shipbuilding firms were surveyed. It was found that 81% of the respondents had no formal reward system encouraging innovative behavior. The study also found that those responsible for innovation and technology transfer generally have an unrealistic view of the competitive position of their firm and the probability of success of technological innovations in process and product changes. The findings of the survey are discussed with regards to proposed changes in reward systems and other areas of future research.



**Title** THE USE OF CHANGE MANAGEMENT TO IMPROVE TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY - PROJECT 30

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10/85	12/86	
3/86	11/86	
6/86	11/86	
11/86	12/86	



# **APPENDIX J**

## **LOW COST DIGITAL IMAGE PHOTOGRAMMETRIC TECHNOLOGY IN SHIPYARDS**

**GCRMTC PROJECT NO. AMTC95-035A**

**Principal Investigator: Clifford J. Mugnier**  
**Department of Civil and Environmental Engineering**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** Photogrammetry is an attractive technology in shipyard applications, but high-priced systems (+\$100,000) discourage most shipyards. Interface software will be developed to adapt inexpensive topographic mapping applications for industrial applications of use in shipyard production environments. A series of "successes" with an industrial collaborator will serve as instructional material useful in publicizing easy, low-cost dimensional control using digital image photogrammetry.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$166,544

FUNDS REMAINING: \$148,000

**ACCOMPLISHMENTS THIS PERIOD:**

**TASK I - Purchase & install development software**

This task has slipped because the purchase and installation of hardware was delayed. Some software has been installed and familiarization with the new system, consisting mainly of Windows 95, WORD for Windows and RoboHelp has commenced. It is expected that all software will be received and development will be progressing by the first week in November. As of the end of the first Quarter, the Microsoft Developer Network (MSDN) software and the Lahey FORTRAN development software have not been received.

**TASK II - Software Design**

Software design is on schedule due to the efforts of Dr. Michael E. Pittman (consultant). The timeline for this task needs to be extended through the end of the second Quarter because the task has turned out to be more involved than expected. The late acquisition of the MSDN and Lahey software has delayed some design activities related to C++ programming.

**TASK III - Software Development**

Development of the menu system will begin during the first week in October with familiarization with the Visual C++ and Winmaker Pro software packages. Receipt of that software was during the middle of September, about two weeks late.



### PROPOSED ACTIVITIES NEXT PERIOD:

- 1) Complete TASK I - Install all software currently in procurement process.
- 2) Complete TASK II - Software Design of the menus for Windows system for shipbuilding applications.
- 3) Continue TASK III - Software Development of the menus for Windows.
- 4) Start TASK IV - Software Documentation based on Windows development and RoboHelp menus.
- 5) Start new project with new Industry Collaborator (Chevron) to perform a parallel project with a new technology (laser camera). Results of this new project may produce a proposal for future research through the NSRP for UNO/GCRMTC and Chevron.

### COLLABORATIVE EFFORTS:

	<u>THIS QTR</u>	<u>YTD</u>
\$ VALUES OF SERVICES FROM INDUSTRY	0	0
IN KIND SERVICES	\$1,500	\$1,500
ACTUAL FUNDS	0	0
\$ VALUES OF SERVICES FROM GOVERNMENT	0	0
IN KIND SERVICES	0	0
ACTUAL FUNDS	0	0

### COMMENTS:

As part of the continuing effort to work with Industry Partners, Avondale Industries, Inc. is working with us to develop an "As-Built" 3-D CAD model of an actual working engine room for an Interference Check. To date, three visits have been made to the ship, the last two visits were photography sessions. Data analysis is currently underway.



# Low-Cost Digital Image Photogrammetry

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# **APPENDIX K**

## **SHIP CAPSIZING (AN ACCURATE AND EFFICIENT TECHNIQUE TO PREDICT SHIP ROLL DAMPING)**

**GCRMTC PROJECT NO. AMTC-036A**

**Principle Investigator: Jeffrey M. Falzarano**  
**Department of Naval Architecture and Marine Engineering**

**Co-Principle Investigator: Richard A. Korpus**  
**Senior Research Scientist, Marine Hydrodynamics (SAIC, Ship Technology)**

**Additional Researcher: Robert M. Fithen**  
**Department of Mechanical Engineering**

**University Of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** This project will develop an accurate and efficient technique to predict ship roll damping using the Finite Analytic Reynolds Averaged Navier Stokes (FA-RANS) solution technique. This capability will be used to improve naval and commercial hull form design with regards to minimizing the most critical resonant roll motions and loads. The approach to be utilized will be to apply progressively more accurate yet computer intensive approximations. Comparisons will be made with existing results and data to be obtained from model and full scale tests. Extensive use will be made of existing SAIC capability and UNO experimental and computer resources including the newly installed UNO Cray J916.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$247,877

FUNDS REMAINING: \$127,934

**ACCOMPLISHMENTS THIS PERIOD:**

During this quarter work continued on the second year's tasks which include work in three areas: development, applications and validation.

1) Development:

Completed 3-D submerged oscillating body with forward speed.

2) Applications:

Completed McDermott application.

3) Validation:

Compared our McDermott results with NSMB model tests.

The approved paper presented to the 15th ASME OMAE was recommended for the *ASME Transactions Journal of Offshore Mechanics and Arctic Engineering*.

**PROPOSED ACTIVITIES NEXT PERIOD:**

1) Development:

Plan to complete surface piercing body.

2) Applications:

Plan to repeat McDermott application for submerged body including comparison with model test results that they have available.



3) Validation:

Depending upon towing tank availability, it is planned to build a 2-D model and use existing PMM. Depending upon availability of McDermott vessel, a full-scale trial will be initiated.

**TIMELINE PROGRESS**

The original and second modified timelines are included for reference. The original timeline has been modified to reflect the fact that additional model test validation is planned.

**COLLABORATIVE EFFORTS:**

**THIS QTR YTD**

**\$ VALUES OF SERVICES FROM INDUSTRY:**

IN KIND: Mr. Mukerjee (Chief NA McDermott)	@\$160/hr	0	2,400
and Mr. Dixon, (Staff NA McDermott Offshore)	@\$50/hr	2,500	3,500
ACTUAL FUNDS (none)		n/a	n/a

**\$ VALUES OF SERVICE FROM GOVERNMENT:**

IN KIND		n/a	n/a
ACTUAL FUNDS (none)		n/a	n/a

**# OF SIGNIFICANT CONTACTS**

INDUSTRY: Mr. Mukerjee (McDermott Offshore),  
Dr. Kokinias (Exxon PR)  
ACADEMIC Prof. Yeung (UC Berkeley), Prof. Cheung (Univ. of Hong Kong)  
GOVERNMENT H. Chatterton (NAVSEA), B. McCrieght (DTRC)

**COMMENTS:** None.



# Ship Capsizing (an Accurate and Efficient Technique to Predict Ship Roll Damping)

[illegible][illegible]



# **APPENDIX L**

## **EVALUATION OF Cr(VI) EXPOSURE LEVELS IN THE SHIPBUILDING INDUSTRY**

**GCRMTC PROJECT NO. AMTC95-032A**

**Principal Investigator: Bhaskar Kura**  
**Department of Civil & Environmental Engineering**

**Additional Investigator: Charles Null**  
**NAVSEA, SCA 03M2**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** Occupational Safety and Health Administration (OSHA) is expected to reduce permissible exposure limits (PELs) of Cr(VI) from  $100 \mu\text{g}/\text{m}^3$  to anywhere between 5 to  $0.5 \mu\text{g}/\text{m}^3$ . A study conducted by the Navy/Industry Task Group organized by NAVSEA revealed that impact of proposed regulations on the shipbuilding industry is significant. The study concluded that the cost of compliance by Navy facilities is as much as \$ 46 Million/year besides a one-time cost of about \$ 22 Million. Also, the task group estimated that cost of compliance by private shipyards is \$ 37 Million/year besides a one-time cost of \$ 9 Million. The task group submitted the study results to OSHA for its consideration while developing the standards.

The main objective of this project is to support the Navy/Industry Task Group activities by, (1) generating additional exposure data for selected shipyard welding processes and (2) evaluating techno-economic feasibility for compliance. The project duration is two years. Project activities include, (1) identification of welding processes for workers' exposure assessment, (2) identification for processes, monitoring, and analysis, (3) sample collection, (4) analysis of airborne particulate samples for Cr(VI) using OSHA's method 215, and (5) evaluation of techno-economic procedures for complying with OSHA's standards. The first four tasks will be completed during the first year. Techno-economic evaluation will be done in the second year.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED:	<u>\$ 92,347</u>
FUNDS REMAINING:	<u>\$ 16,818</u>

**ACCOMPLISHMENTS THIS PERIOD:**

The original tasks and the status of each task are discussed below:

**Task 1: Identification of Welding Processes for Workers' Exposure Assessment**

- This activity was completed in the last quarter. Three welding processes were selected for exposure evaluation. The selected welding processes are, (1) Gas Metal Arc Welding (GMAW) using solid wire on HY 100 metal, (2) Flux Cored Arc Welding (FCAW) on HY 100 metal, and (3) FCAW on DH-36 Steel (ABS Grade).

**Task 2: Identification of Support on Processes, Monitoring, and Analysis**

- Visited Newport News Shipbuilding in July 1996 and discussions were held on the laboratory set up, sampling process, the criteria to be used, monitoring equipment to be used, and the laboratory procedure.



- Quality assurance and quality control (QA/QC) procedures were laid out for the sample collection and analysis.

### **Task 3: Sampling Airborne Emissions of Cr(VI)**

- Sampling of airborne emissions was completed for the two welding methods:
  - (1) Gas Metal Arc Welding (GMAW) using solid wire on HY 100 metal
  - (2) Flux Cored Arc Welding (FCAW) on HY 100 metal
- Seven samples were taken during each welding activity to evaluate the direct exposure of the welder. Also, seven additional area samples were collected for each welding activity to evaluate the indirect exposure of other workers.
- Sampling for the third welding method, FCAW on DH-36 Steel (ABS Grade) is planned for the next quarter. It should be noted that this sampling was not included in the original scope therefore the original budget did not include the cost of this sampling. A total of \$ 12,000 is required for this activity. GCRMTC will be asked for an additional funding increment of
- \$ 8,000 for this activity. NAVSEA has been asked to fund \$ 4,000 of this project. Most likely NAVSEA will fund this activity.

### **Task 4: Analysis of Airborne Particulates for Cr(VI)**

- Summary results of lab analysis for airborne hexavalent chromium (Cr (VI)) and Manganese (Mn) are presented in Table 1 and 2 in this section. OSHA is currently reviewing information on Mn exposure and toxicological effects and lowering of PELs similar to that of Cr(VI) is expected. American Conference of Governmental Industrial Hygienists (ACGIH) has lowered the threshold level value (TLV) for Mn from 1000  $\mu\text{g}/\text{m}^3$  to 200  $\mu\text{g}/\text{m}^3$  recently. Considering the importance of this issue, Mn was also analyzed from the airborne dust although this activity was not originally intended.



**Table 1: Airborne Concentrations of Cr(VI)**

Welding Process	Sampling Type	Arc Time - Range (min.)	Sampling Time - Range (min.)	TWA Values of Airborne Cr(VI) - Range ( $\mu\text{g}/\text{m}^3$ )	8 hr - TWA Values of Airborne Cr(VI)- Range ( $\mu\text{g}/\text{m}^3$ )
GMAW	Area	120-123	128-206	0.2-0.3	0.09-0.12
GMAW	Personal	120-123	178-208	0.2-0.3	0.09-0.12
FCAW	Area	120-121	180-206	0.2-0.3	0.09-0.12
FCAW	Personal	120-121	177-209	0.2-0.3	0.09-0.12

**Table 2: Airborne Concentrations of Mn**

Welding Process	Sampling Type	Arc Time - Range (min.)	Sampling Time - Range (min.)	TWA Values of Airborne Mn - Range ( $\mu\text{g}/\text{m}^3$ )	8 hr - TWA Values of Airborne Mn - Range ( $\mu\text{g}/\text{m}^3$ )
GMAW	AREA	120-123	128-206	65-140	8-61
GMAW	PERSONAL	120-123	178-208	120-585	52-236
FCAW	AREA	120-121	180-206	50-323	19-149
FCAW	PERSONAL	120-121	177-209	298-964	110-335

**Note:**

TWA Time Weighted Average over the sampling time

8hr-TWA Time Weighted Average over 8-hour period

GMAW Gas Metal Arc Welding

FCAW Flux Cored Arc Welding

Interpretation of the results and implications will be discussed in detail in the interim report with additional supporting data.



**PROPOSED ACTIVITIES NEXT PERIOD:**

1. Secure \$ 4,000 from NAVSEA to conduct additional sampling. (An additional \$ 8,000 will be requested from the GCRMTC).
2. Visit Newport News for the necessary planning and sample collection for FCAW on DH-36 Steel (ABS Grade).
3. Complete sample collection and analysis for FCAW on DH36 Steel (ABS Grade) during the next quarter.
4. Develop an interim report for the first year.
5. Plan for the second year activities.

**COLLABORATIVE EFFORTS:****THIS QTR****YTD****\$ VALUES OF SERVICES FROM INDUSTRY:**

IN KIND SERVICES:

2,000<sup>a</sup>

6,000

ACTUAL FUNDS:

**\$ VALUES OF SERVICES FROM GOVERNMENT:**

IN KIND SERVICES:

1,000<sup>b</sup>

3,000

ACTUAL FUNDS:

**No. OF SIGNIFICANT CONTACTS:**

INDUSTRY:

0

2

ACADEMIC:

0

0

GOVERNMENT:

1

2

**COMMENTS:**

<sup>a</sup> Cost of man-hours by the staff of Newport News Shipbuilding Company. Estimated at a total of 20 hours during this quarter. An hourly rate of \$ 100 is used.

<sup>b</sup> Cost of man-hours by the Co-P.I. not charged to the project. Estimated at a total of 10 hours during this quarter. An hourly rate of \$ 100 is used.



c Significant Government contact made this quarter is:

Ms. Kathleen M. Paulson, P.E.  
Mechanical Engineer, Industrial Ventilation Program Lead  
NAVOSH Air Branch, Naval Facilities Engineering Service Center  
Code ESC425, 1100 23rd Avenue  
Port Hueneme, CA 93043-4370

The value of the time spent by the personnel of the Navy/Industry Task Group (Navy Joining Center, Navy Health and Environmental Center, and Electric Boat) is estimated at \$5,000.







# **APPENDIX M**

## **INTEGRATING FIRE-TOLERANT DESIGN AND FABRICATION OF COMPOSITE SHIP STRUCTURES**

**GCRMTC PROJECT NO. AMTC95-033A**

**Principal Investigator: David Hui**  
**Department of Mechanical Engineering**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** The project deals with the integration, design and fabrication of composite materials for marine applications under flammability conditions, and the purpose is to insure that adequate structural strength is present after the material has been exposed to high temperature flames. The primary emphasis is placed on the development of an "analytical" technique involving creep deflection of beams made of composite materials, and this theoretical analysis can be used for predicting the composite material fire tolerance. In order to validate the theoretical creep bending model, some creep bending experiments involving specimens of various sizes will be conducted. The theoretical model will be compared with the experimental results. This is part of the overall effort to build full-scale shipboard structures made of composite materials which will have adequate residual strength in case of fire. The manufacturing and fire testing of full-scale shipboard structures will be performed by contractor under separate request for proposals.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED: \$150,000

FUNDS REMAINING: \$114,000

**ACCOMPLISHMENTS THIS PERIOD:**

**Task 1: LITERATURE SEARCH ON FLAMMABILITY OF STRUCTURES**

April 1-June 30, 1996 Over 100 relevant papers were found and were reported in the last quarterly report. Approximately 10 more papers were found in the period July 1-July 31, 1996.

**Task 2: LITERATURE SEARCH ON CREEP BEHAVIOR OF COMPOSITES**

July 1-Sept. 30, 1996 completed

Task 2a: The literature search revealed the following existing creep theories for composites:

The creep behavior of fiber reinforced composite material beams was studied analytically. As a first approximation, the creep theory for isotropic homogeneous material was extended to include non-isotropic non-homogeneous materials. The preliminary modeling of creep behavior of thermoplastic resin composite was conducted by Xiao (1989), Yen et al (1992), Tuttle and Brinson (1986) and Mosallam et al. (1996). One of the most commonly used models is the Findley Equation, which is essentially a power law as described by Yen et al (1990), and Ma et al. (1996). Most of the available data are for simple tension, and the creep behavior of bending of composite material beams has received relatively little attention. Virtually all the literature deals with composites creep behavior at elevated temperatures or long term durability. None of the above is applicable specifically for fire conditions.



Task 2b: The literature search revealed the following methodology for creep modeling:

The Findley equation for creep behavior of material is used to model the creep behavior of beams under three point bending. Currently, the creep experiments performed at the US Navy Surface Warfare Center are being compared with the extended Findley creep model. The literature shows that there are various creep models, most of which require the quantitative determination of the shift factors (allows one to predict long time creep from short time creep experiments) under different testing conditions. Of particular importance in the theoretical creep modeling is the rate of heating the samples, the one-sided or both sided heating, and the support conditions, in addition to the types of materials. Failure to include these effects leads to significant experimental errors in the creep experiments.

### **Task 3: CRITICAL PARAMETERS FOR CREEP OF COMPOSITES**

Sept. 1, 1996- Sept. 30, 1996 (partial completion)

The available literature shows that in most composites, both the ultimate tensile stress (defined as the maximum stress in the stress versus strain curve) and Young's modulus decreases with increasing temperature. If the composite is characterized by a matrix in terms of low fiber to matrix rule of mixture, the matrix will dominate the creep behavior. The critical parameters are (i) time dependent material properties in tension and compression (ii) support conditions (iii) rate of heating and one-side or two-sided heating, and (iv) shift factors which account for the prediction of the long time creep behavior from short time creep tests.

### **Task 4: SAMPLE EXPERIMENTAL MODELING**

Sept. 1, 1996-Sept 30, 1996 (completed)

Task 4a: Sample composite plate preparation

In preparation for the creep experiments, approximately 150 glass vinyl ester samples (typically used in shipboard structures) were manufactured at the Naval Surface Warfare Center, with size of the square plate being 3"x3".

Task 4b: Test support fixture design for high temperature test

The test support was designed using the ASTM standards for creep behavior of beams, suitable for the Material Testing Machine available at University of New Orleans.

A test rig for open fire conditions was available at the Specialty Plastics company, Baton Rouge. It was re-designed to allow the placement of composite plates of various sizes. The temperature can be varied from room temperature to well over 1000 deg C.



#### Task 4c: Research Results

The following table contains the creep data for time-dependent modulus loss for vinyl ester composite near the glass transition obtained from Usman Sorathia of NSWC Carderock. For temperatures which are well below the glass transition temperature, creep deformation can still be very significant, as seen below in the reduction of the initial modulus and decay time.

Reference Temp (deg C)	Initial Modulus (Gpa)	50% Modulus (Gpa)	Decay time (Hours)
60	18.45	9.23	494.0
70	17.51	8.76	87.8
80	16.24	8.12	15.2
90	15.71	7.86	12.9
100	14.64	7.32	8.8

#### Task 5: THERMAL CONDUCTIVITY OF COMPOSITES

July 1-September 30, 1996

One purpose of the project is to predict and test the thermal conductivity of fiber-reinforced composite laminates. Two independent thermal conductivities were investigated (one longitudinal and one transverse) for the heat conduction behavior of unidirectional composites. The thermal conductivities in the fiber direction and transverse to the fiber direction are vastly different, thus, there is a need to formulate a creep theory for composite material based on fiber angle in the stacking sequence, the volume fraction of the fibers and the types and average length of the fibers and the matrix.

#### PROPOSED ACTIVITIES NEXT PERIOD:

#### Task 3: CRITICAL PARAMETERS FOR CREEP OF COMPOSITES

October 1-December 30, 1996

In the last quarter, the several critical creep parameters were identified. In this quarter, in order to formulate the theoretical creep model, the critical creep parameters will be quantified as a function of both structural and material parameters.

The objective is to predict the creep strength in both tension and compression in the case of bending of composite material beams such that the top fibers are in compression and the bottom fibers are in tension. It appears that the creep modeling is very complicated since the un-burned material properties change with time, and since the tensile and compression properties of the materials has different creep behavior. Further, the burned material retains certain minimum residual strength since the matrix will be burned away, while the fiber will be burned later. Such



creep modeling of composite beams has not been predicted theoretically in the open literature. It is expected that fiber pullout would be more readily occurred at high temperature since the matrix would expand more than the fibers (due to matrix has higher thermal coefficient of expansion) and thus, loosening the grip on the fibers. It is commonly accepted that the power law exponent  $n$  is independent of temperature and stress level, and this will be examined in the case of both tension and compression.

## **TASK 6: DATA REDUCTION FROM EXISTING EXPERIMENTAL RESULTS**

Oct. 1, 1996- Dec. 31, 1996

In September, a series of experimental creep tests on cantilevered square plates (size 3" by 3") at elevated temperatures of 150 deg F were conducted at the Naval Surface Warfare Center. These plates were made of glass vinyl ester with 70% glass fiber volume. Similarly, additional tests will be performed using larger size samples. These experimental results, along with many other earlier ones will be plotted, analyzed, and fitted in the theoretical creep model. Any extraneous experimental data will be treated with suspicion and will require the repeat of the creep experiments. Based on these experimental results and subsequent data reduction, meaningful interpretations of the fire tolerance of composite materials will be made along with design guidelines.

The experimental creep data are being used to allow a curve fit using the Findley equations. This procedure will yield a simple creep model in the three-point bending of beams composed of composite materials. The shift factor equation will be determined to allow the realistic prediction of the whole range of time and temperature based on certain known creep behavior at specific times and temperatures. Such shift factors are determined based on the time it takes for the structure to retain 50% of its residual strength at a given temperature; and this procedure will be repeated for various temperatures.

### **COLLABORATORS:**

#### **Major collaborator:**

Usman Sorathia (US Naval Surface Warfare Center, Annapolis, MD)

#### **Unpaid Consultants**

Su-Seng Pang, Chihdar Yang (Louisiana State University)

Dr. Chun-Hway Hsueh (Oak Ridge National Lab, TN)

Dr. Piyush Dutta (US Army Cold Regions Research and Engineering Lab, Hanover, NH)

Dr. Arnold Mayer (Wright Patterson Air Force Base, Ohio)



**Paid Consultants**

Dr. Ayman Mosallam and Dr. J. Kreiner (California State University, Fullerton, California)

**Graduate Students:**

W.Yip, Bin Dai, Henry Ho, Yvonne Trayham, John Lair

**COLLABORATIVE EFFORTS:****THIS QTR****YTD**

British Petroleum Chemicals, New Jersey

In Kind Service from Aram Mekjian

10 hours x \$50.00/hour

\$ 500

\$1,000

Actual Funds

Supply or resins for making the samples

0

\$ 1,000

from Government

US Naval Surface Warfare Center, Annapolis, MD

(Usman Sorathia)

In Kind Service 40 hours x \$50.00/hour

\$2,000

\$2,800

travel to New Orleans, July 21-26, 1996

\$1,000

\$1,000

US Army Cold Regions Research and Engineering Lab ,  
Hanover, NH (Dr. Piyush Dutta)

In Kind Service 50 hours x \$50.00/hr

\$2,500

\$5,000

Oak Ridge National Laboratory, Oak Ridge, TN

(Dr. C.H. Hsueh)

In Kind Service 20 hours x \$50.00

\$1,000

\$1,500

Wright Patterson Air Force Base, OH

(Dr. Arnold Mayer)

In Kind Service 10 hours x \$50.00

\$ 500

\$ 500

from University

Louisiana State University

Dr. Su-Seng Pang 5 hours x \$50.00

\$ 250

\$ 250

Dr. Chihdar Yang 5 hrsx \$50.00

\$ 250

\$ 250

TOTAL

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 \$8,000

---

 \$12,300

**COMMENTS:** None.



# INTEGRATED FIRE-TOLERANT DESIGN AND FABRICATION OF COMPOSITE SHIP STRUCTURES

Schedule	Status		January				February				March				April				May				June				July				August				September				October				November				December			
	Start	Final	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4												
1. literature search structures	4/1/86	6/30/86																																																
	4/1/86	6/30/86																																																
2. literature search composites	7/1/86	9/30/86																																																
	7/1/86	9/30/86																																																
3. critical parameter for creep	9/1/86	3/31/87																																																
	9/1/86	3/31/87																																																
4 sample experimental modelling	9/1/86	9/30/86																																																
	9/1/86	9/30/86																																																
5 thermal conductivity	7/1/86	9/30/86																																																
	7/1/86	9/30/86																																																
6 data reduction	10/1/86	3/31/87																																																
	10/1/86	3/31/87																																																



# **APPENDIX N**

## **SHOCK REDUCTION OF PLANING BOATS**

**GCRMTC PROJECT NO. AMTC95-041A**

**Principal Investigator: William S. Vorus**  
**Department of Naval Architecture and Marine Engineering**

**University of New Orleans**  
**New Orleans, LA 70148**



**PROJECT SYNOPSIS:** The problem addressed is the operational constraints imposed on planing craft by wave impact acceleration. From strength and operational points of view, planing craft can generally operate in a seaway at higher speeds than is commonly practiced. The speed reducing limitation is imposed by the inability of human occupants to withstand the shock associated with pounding through waves.

The objective of this research is to develop design technology for reducing the impact shock severity aboard planing craft, at the occupant level, and thereby making possible the expansion of boat operating-speed versus wave-height envelopes.

The approach being followed is first theoretical hydro-mechanical analysis of possible innovations. This will be followed by experimental confirmation of the effectiveness of candidate approaches, culminating in prototype development and sea testing.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED:	<u>\$147,714</u>
FUNDS REMAINING:	<u>\$112,000</u>

**ACCOMPLISHMENTS THIS PERIOD:**

The time line from the last quarter report showing the projected schedule by task for 1996 is included herewith as Figure 1. The lightened bars on Figure 1 for each task represent the new projected schedule on the basis of accomplishments in the third quarter; as can be seen the project remains on schedule for completion of the original 1996 work objectives.

By task, the accomplishments in the third quarter have been:

**Task 1:** Expand Level I Model to Include Hull Strakes  
(Completed ahead of schedule as described in 2nd quarter report.)

**Task 2:** Verify by Comparison with Drop Tests

The University of Michigan, under GCRMTC sub-contract, has confirmed that the predicted level of effect of hull strakes on impact forces is representative on the basis of comparison with experimental drop-test data collected by NSWC/CSS, Panama City. Close one-to-one comparison has not been possible because the drop test at CSS were on actual boats with strakes, whereas the calculated levels (2nd Q report) were for cylindrical sections. This task is however considered complete, although further test on strake effects is anticipated when drop tests with cylinders are conducted in later years of the research program (refer to AMTC95-041A Four-year proposal).

**Task 3:** Expand Level II Model for Sprung Sub-systems

Here, a slight deviation has been effected in the details of the Task 3 objective. As planned in the original proposal, the most promising concept for shock reduction was expected to be "spring-mounting" of an inner hull to achieve shock isolation through conventional "suspension" concepts. However, in the process of the second quarter work, as addressed in the 2nd quarter progress report, "smart hull surfaces" has been conceived has the top candidate approach for achieving the project



objectives. This involves exploitation of the rapidly advancing technologies of Compliant Surfaces and Adaptive Controls.

The initial analysis is on a simple compliant surface system to try to understand the basic sensitivities of shock loads and acceleration to temporal variations of the planing boat hull hydrodynamic hull surfaces, Figure 2. It was found in exercising the level I computer program earlier in the year that, due to the nonlinearity of the large transverse perturbation, impact loads are extremely sensitive to hull geometry. The idea of Figure 2 is to hinge the hull along the keel, with the hull sides attached to a base inner hull by either active actuators or passive springs and dashpots, or combinations. The idea is to rapidly increase the deadrise angle by a few degrees to produce a suction just as the section is impacting the water surface, thereby producing cancellation in the impact force and reducing net impact force and resulting acceleration.

The extension of the level I hydrodynamic model to level II to allow analysis of the Figure 2 physics of interest was completed in the third quarter.

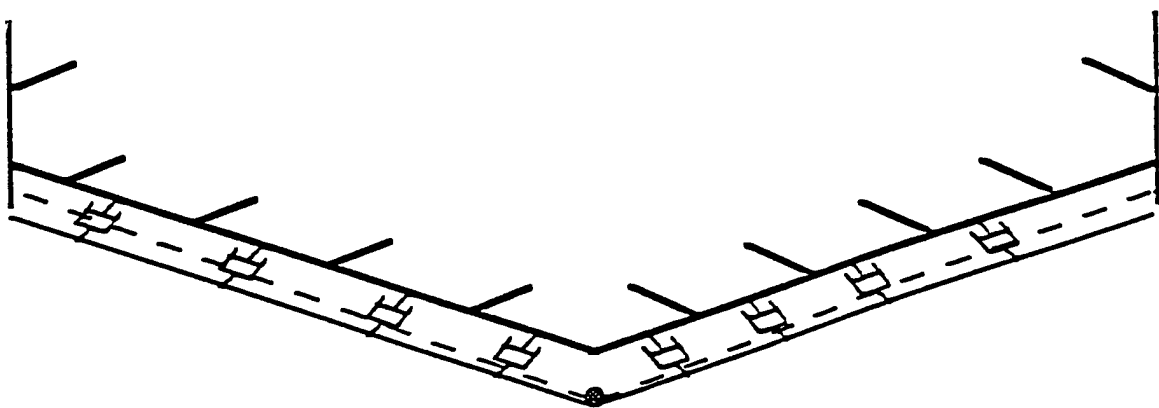
#### **Task 4: Select Candidate Concepts for 1st Level Analysis**

Statement of this task will henceforth be corrected as "Select Candidate Concepts for 2nd Level Analysis."

Task 4 has been completed with the selection of "compliant hull surfaces" as the top candidate concept for achieving the project objectives.

#### **Task 5: Select Base Hull for Comparison**

The base hull selected is a cylinder with an initial, base, deadrise angle of 15 degrees. This configuration will be generalized in the progress of Task 6 as the driving physics is sorted-out and understood on the basis of the simplified Figure 2 configuration (with 15 degrees of deadrise angle in the undeflected state).



**FIGURE 2: Smart Planing Surfaces**



### **Task 6: Perform Comparative Evaluation Using Level II Analysis**

The analysis of the 15-degree deadrise cylinder with hinged keel of Figure 2 was begun in the third quarter. The initial analysis was for a prescribed deadrise angle variation in time as the cylinder impacts the calm water surface in free-fall; the free-fall calm-water impact represents the drop-tests whose results are the initial interest.

The deadrise angle,  $b$ , was varied between 15 and 20 degrees along a number of trial time paths. Figure 3 shows a sample of one of the  $b(t)$  characteristics investigated;  $t$  is non-dimensional time.

Figure 4 shows the characteristics versus time with the Figure 3  $b$ -variation, along with the characteristics for cylinders with fixed deadrise angles of 15 and 20 degrees. The non-dimensional weight and gravity coefficients noted on Figure 4 would be typical of the typical planing craft. The three sets of curves shown are the prescribed  $b(t)$ , the impact acceleration,  $v(\tau)$ , and the (negative of the) impact velocity,  $v(\tau)$ , the velocity and acceleration being positive up. It is seen from Figure 4 that:

- 1) There is a beneficial effect on the level of impact acceleration with increased deadrise angle; this is well known if not here-to-fore well quantified.

- 2) The impact performance of the 20-degree hull can be achieved with the base 15-degree hull with a very quick initial increase in  $b$  as the cylinder contacts the water surface. The time scale of events on Figure 4 can be appreciated in consideration of the positions of the acceleration singularities that occur at relative large times on Figure 4; these singularities occur at chine wetting in the impact event.

It is expected that greater reductions in impact acceleration are achievable with the concept under exploration in Task 6. The Figure 4 result is not considered as indicative of the potential of the concept planing hulls with "smart surface" shock reduction. The work continues.

### **PROPOSED ACTIVITIES NEXT PERIOD:**

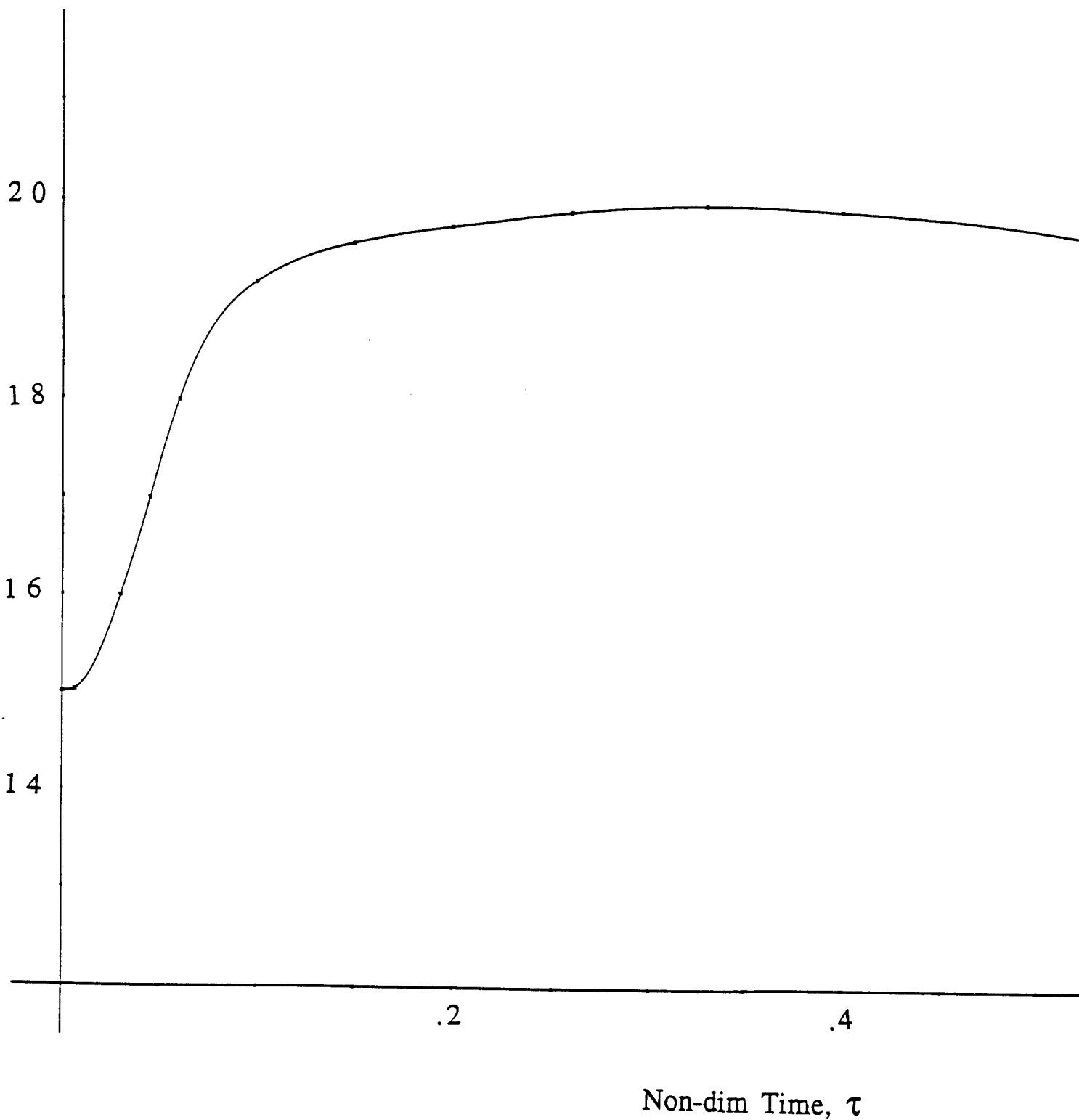
As shown on Figure 1, the only currently active Task that continues into the fourth quarter is Task 6.

On the basis of the results of the rather exhaustive computations performed with specified deadrise angle variation (typical of Figure 4), the analysis will be shifted in the 4th quarter to evaluating the potential for passive systems of springs and dashpots in the Figure 2 model. That is, a relationship will be formulated between the time-developing impact force and the side-hull deflection in terms of displacement-dependent (spring) and rate-dependent (dashpot) elements. It now appears likely that the hull might most effectively help to determine its own deflection characteristics for minimum impact through this type of interaction mechanism.

It is intended that the potential for the "smart surface" shock reduction can be established, either pro or con, by the end of the year, as indicated on the Figure 1 timeline.

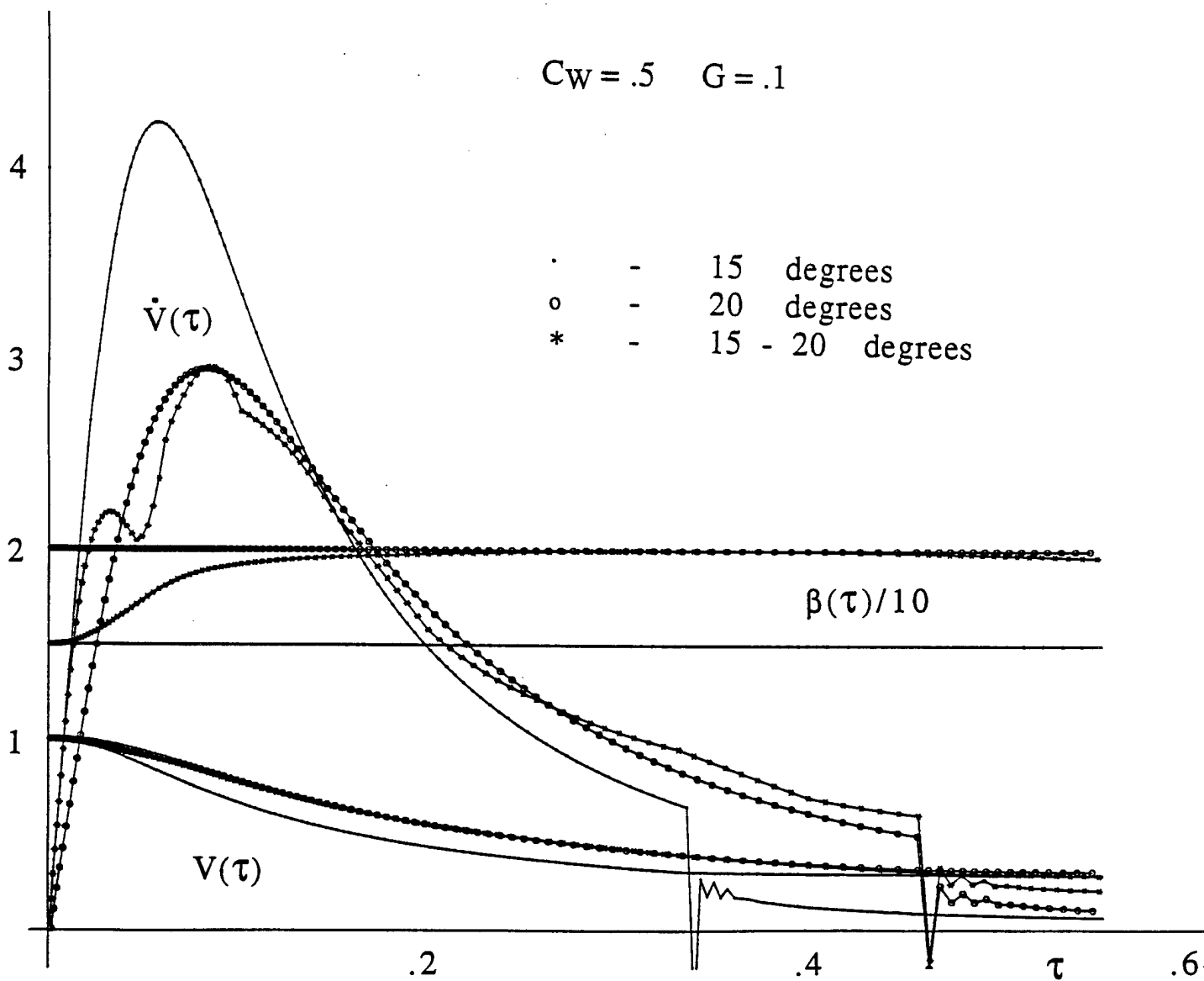


●  $\beta(\tau)$ , degrees



**FIGURE 3:** Deadrise Angle Variation versus Time





**FIGURE 4: Velocity and Acceleration Characteristics with  $\beta$  Variation**



**COLLABORATIVE EFFORTS:****THIS QTR****YTD****\$ VALUES OF SERVICES FROM INDUSTRY****0****0****IN KIND SERVICES****0****0****ACTUAL FUNDS****0****0****\$ VALUES OF SERVICES FROM GOVERNMENT****0****0****IN KIND SERVICES****0****0****ACTUAL FUNDS****0****0****NUMBER OF SIGNIFICANT CONTACTS:****INDUSTRY: Mr. Anil Raj, Halter Marine****ACADEMIC:****GOVERNMENT: Dr. Ronald Peterson, NSWCCS****COMMENTS: None.**



[illegible]



# **APPENDIX O**

## **Ship Propeller Thrust and Torque Measurement**

**GCRMTC PROJECT NO. AMTC95-0531A**

**Principal Researcher: Paul M. Chirlian**  
**Electrical Engineering**

**Additional Researcher: Russell E. Trahan, Jr.**  
**Electrical Engineering**

**Additional Researcher: Yiangyang Yang**  
**Electrical Engineering**

**Additional Researcher: William S. Vorus**  
**Naval Architecture and Marine Engineering**

**University of New Orleans**  
**New Orleans, LA 71048**



**PROJECT SYNOPSIS:** This project is to provide instrumentation, based on fiber optic methods, to measure ship shaft thrust and torque accurately. Optical methods are free from electrical interference and can be extremely accurate. Thrust will be determined by measuring the deflection (compression) of a relatively short section of propeller shaft. This deflection will be measured by clamping one end of a one meter collar to the shaft. The relative linear displacement of the free end of the collar and the shaft directly under it will be compared using optical techniques. At the present time it is proposed to use moire patterns, in conjunction with timing marks on the rotating shaft, to very accurately measure the deflection of the shaft. Torque will be measured using a similar collar clamped at one end. The relative rotational deflection of the free end of the collar and the free end of the shaft will be determined. The torque meter will be evolved from a successful torque meter that has been developed jointly by UNO and Omni Technologies, Inc.

**BUDGET STATUS:**

TOTAL AMOUNT BUDGETED:                    \$250,389

FUNDS REMAINING:                            \$250,389

**ACCOMPLISHMENTS THIS PERIOD:**

The project has been in operation for one month. Equipment has been ordered which will provide basic optical measurement and design facilities. An electrical data acquisition system was ordered. A study of moire pattern physics and measurements was initiated. In previous studies only measurements of thrust were made using strain gage measurement. Comparisons of procedures used to measure torque were made prior to a decision on the implementation of a measurement scheme. It should be noted that, where possible, the thrust and torque measurement procedures should make use of the same collar and optics.

**ORIGINAL TASKS:** During the first month of the project only Task 1, a state of the art survey, was scheduled for implementation.

**STATUS OF ORIGINAL TASKS:** Task 1 is to be a three month study. As noted above this task has been initiated in conjunction with other start-up operations.

**Task 1**

- Study of morie patterns initiated
- Literature search initiated
- Patent search initiated



**PROPOSED ACTIVITIES NEXT PERIOD:**

The task 1 activities will be completed. The redesign of the torque meter will be considered for much of the period. The basic design of thrust measurement will be initiated.

**COLLABORATIVE EFFORTS:**

When a prototype is developed collaborative activities with shipyards will be initiated.

**COMMENTS:**

The Budget Status amounts reflect the budget statement of 9/09/96. Orders for equipment and supplies in the amount of \$10,222 have been placed.



# Ship Propeller Thrust and Torque Management

TASKS		TIME IN MONTHS																							
No.	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	STATE OF THE ART SURVEY	old	new																						
2	REDESIGN TORSIONMETER						old	new																	
3	BASIC DESIGN OF THRUST MEASUREMENT											old	new												
4	MODEL CONSTRUCTION AND MODIFICATION																	old	new						
5	INTERIM REPORT																								
6	IDENTIFY SHIPS FOR TESTING																			old	new				
7	INSTALL AND EVALUAT PROTOTYPE																				old	new			
8	DATA ANALYSIS																						old	new	
9	FINAL REPORT PREPARATION																								



# **APPENDIX P**

## **MACSEA SUBCONTRACT REPORT**

**University of New Orleans  
New Orleans, LA 70148**



# **Quarterly Progress Report #1**

Subcontract #20; UNO #327-01-5100  
Agreement No. N00014-94-2-0011

Prepared for:

Gulf Coast Maritime Technology Center  
University of New Orleans  
212 Engineering Building  
New Orleans, Louisiana 70148

Prepared by:



MACSEA Ltd.  
163 Water Street  
Stonington, Connecticut 06378  
Tel: (860) 535-3885 Fax: (860) 535-3357  
e-mail: [macsea@connix.com](mailto:macsea@connix.com)



**MACSEA Ltd.**  
**Quarterly Report #1**

**Report Period:** June 1, 1996 to October 18, 1996  
**Project:** *Automated Learning of Diesel Engine Operating Characteristics*  
**Principal Investigator:** Mr. Kevin P. Logan

**Brief Synopsis:**

This is the initial quarterly report for this project. The specific objectives of this research are as follows:

1. To develop automated machine learning techniques that can detect changes in a diesel engine's operating characteristics over time. Knowledge of such changes can lead to the determination of incipient engine problems before catastrophic failure occurs, thereby minimizing unplanned machinery breakdowns and maximizing reliability and readiness. When incorporated into a fully integrated engine monitoring, performance analysis, and diagnostic system as part of a U.S. built advanced technology ship, such techniques can provide an effective tool for minimizing maintenance and repair costs, as well as engine operating costs. Lower life cycle costs of U.S. built ships can improve the competitiveness of the U.S. shipbuilding industry in the international market.
2. To apply these techniques to learn the nonlinear relationships among key engine variables. The representation of these relationships can then be used for recall purposes, wherein a machine-computed estimate of a particular parameter can be generated on the basis of the other parameters. This opens up the possibility of employing the representation for data fusion and analytically redundant sensor estimation, with a direct application to sensor diagnostics.

**Budget Status:**

**Total Amount Budgeted:** \$111,986.00  
**Funds Remaining:** \$87,016.82

**Accomplishments This Period:**

**Task 1: Design Simulation Experiments**

- Performed a review of the simulation facilities including the UNO/ECN code and MERLIN engine simulation computer programs. This comprised a visit to UNO and a thorough review of "Engine Performance Simulation with UNO/ECN Code," a GCRMTC report by Dr. Bahadir Inozu, published July 11, 1995, and the MERLIN Combustion Engine System Simulation Program User Manual, by Lloyd's Register, dated January 30, 1995.



## **Accomplishments This Period:**

### **Task 1: Design Simulation Experiments (continued)**

- Agreed with UNO on an iterative approach to the simulations. Such an approach is preferable to MACSEA because unforeseen conditions may occur during the course of this research. If all of the simulations had to be requested before any artificial neural network training trials occur, the request would have to be very comprehensive. With this approach, much of UNO's simulation effort could be wasted. And if a completely unforeseen condition were to occur, MACSEA's research efforts would be hampered by a lack of appropriate data. By requesting simulation output as the need for it becomes clear, a more efficient and effective experiment will be performed.

- Obtained a complete description from UNO of the preferred content of a simulation run request.

- Requested initial simulation run. The purpose of this first run was to create a small set of example output files. MACSEA examined these outputs for the purpose of designing the front end software required to conduct artificial neural network training trials.

### **Task 2: Conduct Simulation Trials:**

- With UNO, set up a means of efficient file transfer between UNO and MACSEA computers. UNO set up an account on a UNO computer and MACSEA tested its ability to log in to the account remotely and transfer files back to MACSEA.

- UNO performed the simulation run mentioned above and posted the results in the account. MACSEA copied these data files to MACSEA computers.

The above activities were performed to facilitate future collaboration between UNO and MACSEA.

### **Task 3: Develop Real Time Neural Network Learning Techniques**

- Performed neural network literature search and review relating to function estimation and associative memory, with a special interest in spatially localized learning techniques and implementation of real-time learning. These two interests are related: during on-line learning of a time-varying process, the representation of early data will eventually be lost if a global method is used. To preserve early training, a spatially localized learning technique is required. A draft of the matrix in which MACSEA is storing a summary of some relevant points disclosed during the search and review is enclosed.

- Completed initial selection of an artificial neural network development environment. The two most stringent requirements for such an environment are: additional neural network models must be easily implemented, and the networks produced must be compilable into 'C' programs such



that they can continue to learn, and not merely recall previous training. A matrix containing a summary of some of the relevant properties of candidate environments is enclosed.

#### **Task 4: Conduct Neural Network Training Trials**

- Examined the output of the initial UNO/ECN simulation run.
- Began design of front-end data processing software needed to transform simulation output into input needed to train artificial neural systems.
- Designed and implemented front-end data processing software needed to transform MACSEA acquired power trial data into input needed to train artificial neural systems. The data recorded at sea is being reviewed to support engine parameter selection for simulation runs.
- Selected a subset of engine parameters to be used in a sensor redundancy experiment.
- Using the pre-processing software mentioned above, built a database for neural network training that contains time samples of these data items.
- Performed an initial baseline trial of a network for sensor redundancy. This initial run used a backpropagation type artificial neural network trained as a linear autoassociator of the test data parameters. The enclosed charts give examples of the result of testing the network with the training data – the least demanding test possible. The legend indicates “tagname” for the actual data, and “tagname^” for the network estimate of that data. The charts indicate that although a linear autoassociation is adequate to reproduce some of the selected data items (such as engine rpm), it is inadequate to estimate others (such as main bearing temperature). A network capable of nonlinear autoassociation will be required.

#### **Proposed Activities Next Period:**

##### **Task 1: Design Simulation Experiments:**

- Complete a file format specification for simulation data sets for artificial neural network processing.
- Request a series of steady state and transient simulation runs that will represent the full operating range of the engine parameters being studied.

##### **Task 2: Conduct Simulation Trials:**

- UNO will perform the above-mentioned simulation runs.



### **Task 3: Develop Real Time Neural Network Learning Techniques:**

- Complete the search and review of the artificial neural network literature relating to function estimation and associative memory, especially spatially localized learning techniques and implementation of real-time learning. Complete study and selection of candidate artificial neural network learning techniques.

### **Task 4: Conduct Neural Network Training Trials:**

- Complete a series of experiments using an off-line global training method (i.e. multi-layer perceptron artificial neural networks trained using backpropagation) as a performance baseline for future real-time learning methods. It is important to ensure that the on-line training using spatially localized learning techniques to be developed will be as effective as off-line global techniques.

### **Explanation of Changes to Schedule:**

#### **Task 1: Design Simulation Experiments:**

- Agreed with UNO on an iterative approach to the simulations. Such an approach is preferable to MACSEA because unforeseen conditions may occur during the course of this research. If all of the simulations had to be requested before any artificial neural network training trials occur, the request would have to be very comprehensive. With this approach, much of UNO's simulation effort could be wasted. And if a completely unforeseen condition were to occur, MACSEA's research efforts would be hampered by a lack of appropriate data. By requesting simulation output as the need for it becomes clear, a more efficient and effective experiment will be performed.

#### **Task 2: Conduct Simulation Trials:**

- The schedule of simulation trials was stretched out to reflect the change in philosophy of design of simulation experiments described above.

#### **Task 3: Develop Real Time Neural Network Learning Techniques:**

#### **Task 4: Conduct Neural Network Training Trials:**

- These tasks were begun much earlier than planned for the following reasons:

1. The selection of artificial neural network architectures affects the selection of a development environment.
2. The selection of a development environment in turn affects the required input file format specification for simulated data.
3. The conduct of neural network training trials informs the selection of engine parameters in simulation runs.
4. MACSEA wanted to begin specifying engine simulation runs as soon as possible.



# Time Line MACSEA Quarterly Report #1

Schedule	Status		Time Line												May-97
	Start	Final	Jun-96	Jul-96	Aug-96	Sep-96	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97		
1. Design Simulation Experiments	6/1/96	10/1/97	1	2	3	4	1	2	3	4	1	2	3	4	1
	6/1/96	7/31/96													2
															3
															4
2.0 Conduct Simulation Trials	8/1/96	2/20/97													
	8/1/96	9/30/96													
3.0 Develop Machine Learning Techniqu	7/21/96	10/1/97													
	10/1/96	10/1/97													
4.0 Conduct Machine Learning Trials	10/1/96	4/30/97													
	2/1/97	4/30/97													
5.0 Project Management/Reporting	5/1/97	5/30/97													
	5/1/97	5/30/97													



# **APPENDIX Q**

## **ROCKWELL SUBCONTRACT REPORT**

**University of New Orleans  
New Orleans, LA 70148**





## **North American Aircraft**

September 26, 1996

In Reply Refer to:  
96L-0100 -405CA

Dr. John N. Crisp  
Executive Director  
Gulf Coast Region Maritime Technology Center  
211 Engineering Building  
University of New Orleans  
New Orleans, LA 70148

Subject: Agreement No. N00014-94-2-0011, UNO Account No. 327-01-5100, sub Contract # 22;  
Quarterly Status Report #1, June/July/August 1996

Dr. John Crisp:

### **INTRODUCTION**

This is the first quarterly status report for the University of New Orleans agreement no. N00014-94-2-011, UNO Account No. 327-01-5100, Sub Contract #22 for the period 03 June 1996 through 30 August 1996. The subcontract is being performed by Rockwell Aerospace North American Aircraft Division in the Seal Beach California facility. Rockwell's program manager is Mr. Charles Amaral who has full responsibility for the program's technical content, budget and performance.

This quarterly report covers the progress, problems, and expenditures for the subcontract efforts. Ten tasks have been identified revolving around two build iterations as described in the statement of work. These tasks are aligned with the needs the GCRMTC has identified in the Request for Proposal No. 5676. Rockwell's AIE team will use its System Enterprise Methodology (SEM) process to guide the efforts on these tasks.

### **SOCp INVOLVEMENT:**

Rockwell has submitted its application to become an associate member of the SOCP. This project is an expansion of an effort the SOCP has had in development for over 2 years. Here, Rockwell personnel need to remain cognizant of the progress of the software projects that the SOCP has in development for the Ship Owners and Operators. Date, Shipper, and Spin will have access to the same database the Ship Yards will require. With this cooperative venture in mind Rockwell conducted a Workshop for the SOCP panel at the SEALAND facilities located in Charlotte, NC.. The workshop was held on the 19-21 August 1996.

In this Workshop Rockwell's Rick Bsharah gave a six hour tutorial on the SEM for the benefit of the SOCP Panel members. Additionally, Dr. Bahadir Inozu and Mr. Peter Schaedel gave a progress report on the SOCP RAM database effort and Mr. Zbigniew Karaszewski, program manager, for the National Maritime Center, United States Coast Guard gave a briefing the MSTEP project. The rationale, here, is that all three of these project will be integrated into one RAM database in the future. The necessity of Rockwell involvement is obvious to insure the success of this project.

The results of this workshop was the SOCP RAM project elected to follow the SEM process in its development work. A second meeting has been requested by the SOCP RAM panel and is slated for the



22-24 October '96 and will be held in Maryland. At this session Rockwell will assist the SOCP in developing some Units of Functionality (UoF) for their usage.

For further details see the Minutes of the Ram Database Strategic Planning Session dated 09/14/96 and submitted by Dr. Bahadir Inozu.

## **TECHNICAL RESULTS BY TASK**

### **TASK 1 SEM TRAINING**

The SEM training will involve an overview of the methodology that will be used to perform the tasks of this project. Rockwell's Advanced Information Engineering group has developed the Systems Enterprise Methodology (SEM) a unique system of organizing a structured approach to any large system that will require a method of staging a development procedure by modeling techniques to develop a fully developed data model for systems development.

The SEM will be performed by Rockwell personnel. However, the Resource Experts (representatives from the participating Ship Designers, Ship Yards, Manufactures, and Vendors) have a need to understand this process that will require their input from time to time. As the resource experts they will be required to provide information to the requirements personnel (Rockwell) to assist in the development of an "AS-IS" Scenario.

The SEM training will be given at the Workshop that has been scheduled to be held on the 24th & 25th of Sept. 1996. Newport News Shipbuilding in Newport News, Virginia will host this meeting at their facilities. Personnel for the training will be members of Ship Design, Ship Building,, Ship Manufacturing and Vendors

At the Yard RAM Workshop September 24 & 25, 1996 at the Newport News Shipyard facilities Rockwell personnel gave a tutorial on the System Enterprise Methodology (SEM) on the second Rockwell led the group in a workshop atmosphere and use the SEM to create some UoFs review the AS-IS model and visit the Resource process model that Rockwell has been developing.

### **TASK 2 STRATEGIC PLANNING**

A Workshop session has been established that will be held at the Newport News Shipyard facilities in Virginia. This kick-off meeting will be held on the 24th & 25th of September 1996. Attachment A is an agenda for the Workshop. Over twenty invitations have been FAXED to a list of Ship Designers, Ship Yards, Manufacturers, Vendors, and regulatory agencies.

The strategic planning section is the part that will determine what task will be done by who and where. Here, task assignments will be established for the entire project. Prior to this planning session an overview of the SOCP's Date, Shipper, and Spin will be given in addition to the overview of the SEM methodology.

With this new knowledge the work group will be able to proceed with the strategic plan for the entire project.

At the Workshop session held on the 24 & 25 of September '96 the entire group of attendees work on developing a VISION STATEMENT for the project team:



## **TO - BE VISION STATEMENT**

**TO PRODUCE THE MOST COMPREHENSIVE TECHNICAL AND HISTORICAL INFORMATION NETWORK TO SUPPORT THE OPTIMIZATION OF MERCHANT SHIPS RELIABILITY AND COST EFFECTIVENESS FOR ANY STAGE OF THE SHIP LIFE CYCLE PERFORMANCE.**

### **TASK 3 BUILD ONE REQUIREMENTS DEFINITION**

The Rockwell team is establishing a rapport with the user environment. The team has visited various user sites and attended various functions that are pertinent to the objectives of this project. This projects prime objective is to determine how to expand the Ship Operations Cooperative Program's (SOCP) Reliability, Availability, and Maintainability (RAM) project out to the Ship Designers, Ship Builders, Vendors, and Manufacturers. A close relationship between this project and the SOCP effort is essential for the successful conclusion and recommendation of this projects goal. The eventual integration of these projects will take place to form a complete life cycle approach to maintaining ships and their component products.

In the requirements gathering it has been established that there are two avenues established in developing a RAM database under the current conditions: (1) A minimum of commercial ships have been built in the United States in the past several years. The means of collecting data in this time period has been a manual process. Gathering the required information for an automated system will mean analyzing existing data in what ever form and converting it into a digital standard format that can be shared by many. This is referred to as "LEGACY DATA". (2) There is in existence today the building of some new ships and the preliminary design of more ships that will be developed in U.S. Shipyards. Here, the opportunity exist to gather information as the ship is in design and under construction in the Shipyard. The ability to gather the actual information in it's infancy affords the opportunity to establish a system with "BASELINE DATA". This baseline system will expedite the maintenance plan for a new ship and create a means of configuration management of a ship from the "AS-BUILT" stage and throughout the full life cycle. This analyses is essential to establishing a base platform for the requirements effort.

Rockwell personnel have started work on developing a Process Flow Model. This process flow is specific to the machinery and propulsion systems and will concentrate on the RAM of those systems. Initial efforts have been developing a network communications with the user environment. Site visits and interviews are used to establish Units of Functionality (UoF) and functional analysis.

At the Workshop held on the 24 & 25 of September at Newport News Shipyard Rockwell lead the session in developing Units of Functionality, once the group received the SEM training they now had the ability to establish these UoFs. In addition, the group went on to prioritize the UoFs this prioritization will now lead the Build One Development and other UoFs defined in Build One will then become the foundation for Build two segment.

### **TASK 4 BUILD ONE DESIGN**

**As a result of the Workshop held for the Ship Designers, Shipyards, Manufacturers, and Vendors the Build One Design (Task 4) is well underway**



- TASK 5 BUILD ONE DEVELOPMENT
- TASK 6 BUILD ONE ASSESSMENT
- TASK 7 BUILD TWO REQUIREMENTS DEFINITION
- TASK 8 BUILD TWO DESIGN
- TASK 9 BUILD TWO PROTOTYPE DEVELOPMENT
- TASK 10 BUILD TWO ASSESSMENT
- TASK 11 PROJECT MANAGEMENT

## **SHIPYARD ACTIVITY**

### **NASSCO**

Rockwell has established a means of communication with ;National Steel and Shipbuilding Company (NASSCO) of San Diego, CA and ARCO Marine, Inc. of Long Beach, CA. on the 23rd of August '96, Chuck Amaral and Vernon Kimura of Rockwell traveled to NASSCO facilities and met with David Van Patten, Manager, Integrated Logistics and Chuck Byrne, Logistics Engineer - LSA. This technical exchange involved an overview of this project and the SEM methodology from Rockwell and an overview of the Logistics environment in a shipyard from NASSCO. Chuck Byrne is certified in Reliability-Centered Maintenance and gave Rockwell a brief tutorial on RCM.

In July Chuck Amaral attended a meeting with Dr. Bahadir Inozu of the UNO and ARCO personnel in the ARCO facilities located in Long Beach, CA.. At this session Rockwell discovered that a Mr. William Croke of ARCO was involved in a preliminary design exercise with NASSCO for a new ship. ARCO informed Rockwell that interface with NASSCO was a Mr. Steve Strifer, Design Engineer.

This trilogy has the potential of a proof of concept scenario for the development of a BASELINE RAM system for a commercial United States ship. The requirements gathering would begin with the preliminary design through final design, build, operate .

On August 29th, Chuck Amaral and Vernon Kimura attended a meeting with Mr. Charlie Eilhardt, principal surveyor, for the American Bureau of Shipping (ABS) Long Beach, CA office. The general discussion was on ABSs role in the shipping world and more specifically the building of new ships. Mr. Eilhardt presented Rockwell with a copy of "Rules for Building and Classing Steel Vessels 1996. This reference will assist Rockwell in the Development of the RAM.

### **NEWPORT NEWS SHIPBUILDING**

Newport News Shipbuilding was one of the first to sign to this project and continued to support through the proposal cycle and the extensive time before award. Newport News determine that the cannot support all the efforts that are going around with in-kind contributions. In order to support this project they would need resources for labor and travel. Because of the essential need for Newport News Rockwell agreed to pay for two personnel to support at a cost of \$10,000, plus \$2,000 for travel expenses. The agreement is now in effect.



As mentioned previously Newport News Shipbuilding will host the first workshop in their facility in Newport News, VA. on the 24-25 September '96.

#### **SCHEDULE STATUS**

The project is on schedule and within cost. Further details can be viewed in the Financial Status Report. attached.

#### **ACTUAL VS PLANNED MANPOWER**

Man power is as planned personnel involved in the development of the Project have been Charles Amaral, Program Manager, Vernon Kimura, Rick Bsharah, Dr. Emily Howard, Dr. Bahadir Inozu, Doug Rhynd, William Crawford

#### **ACCOMPLISHMENTS**

- 1.) Held first joint session meeting/workshop with the SOCP RAM committee
- 2.) Submitted SOCP associate membership application
- 3.) Established association with ABS
- 4.) Newport News Shipbuilding under agreement as team member
- 5.) NASSCO Shipbuilding agreement to join team
- 6.) Activity model established
- 7.) Established joint effort with ASTM standards committee
- 8.) Recognition for Maritime RAM at the IPO/ISO standards committees
- 9.) Visits to Shipyards and Ship Operations
- 10.) Acquired reference data:
  - Rules for Building and Classing Steel Vessels 1996
  - Federal Regulation Register 46 CFR (SHIPPING) parts 41-69 and 90-139
  - NIDDESC Application Protocols
  - Reliability-Centered Maintenance Handbook (Naval Sea Systems Command)
- 11.) Rockwell has acquired copies of DATE & SHIPPER and downloaded on two PCs at the Rockwell facilities located in Seal Beach, CA.
- 12.) Conducted a workshop for the SOCP members August 19-21, '96 at Sealand facilities in Charlotte, NC.
- 13.) Conducted a two day workshop for the Ship Designers, Shipyards, Manufacturer and Vendors at the Newport News Shipyard facilities, located in Newport News, VA on the 24-25 of September '96.



- 14.) Scheduling the second Workshop to be held at the University of New Orleans (UNO) in January, this will be a joint session between the Ship Owners and Operators, and the Ship Designers, Ship Yards, Manufacturers, and Vendors.
- 15.) Started development of the Process Flow Model for Ships Machinery and propulsion systems.

#### KEY TECHNICAL ISSUES

The main issue is the integration of the Yard RAM with the SOCP effort.

Integration with the Coast Guard's MSTEP program.

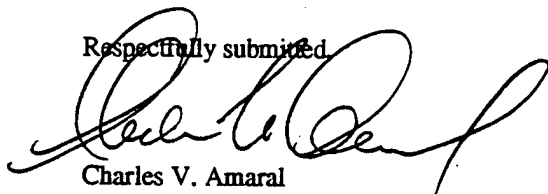
#### CONCLUSIONS AND RECOMMENDATIONS

This project is establishing a network of communications throughout the Maritime Industry. The sharing of information will be unique to the industry. Conducted meetings with the Ship Operators and Owners, and the Ship Designers, Ship Builders, Manufacturers, and Vendors will knock down the barriers that have been developed over a number of years. It is anticipated by all involved that there will be near term and long terms derived from the merging of the SOCP effort and this effort.

Taking part in standards development and working with the regulatory agencies will reduce the boundaries that have existed. The SEM is designed to bring structure to an activity the ground has been established and the Build process is beginning to take effect as planned. It is now anticipated that the result of this project will grow rapidly and the implementation will expand within a few years the long term results will impact the Maritime Industry World Wide. It is difficult to scope what impact this will have in the long term. The potential may be mind boggling.

It is a recommendation that while this study is in progress other areas of the ship should be included. An example of this would be Ship's Structures. The SEM methodology is designed to be flexible and can enter a project at any stage of development and incorporate new projects within the module structure of the SEM at any point and without disrupting the flow. These tasks can be added without a lot of paper redtape. Adding a statement to the existing Statement of Work (SOW) would relieve the RFP and Contract negotiations process. This action would not only save money but precious hours as well.

Respectfully submitted,



Charles V. Amaral  
Project Manager Maritime  
Advanced Information Engineering



**ATTENDEES LIST FOR THE RAM MEETING  
24/25 SEPTEMBER 1996  
NEWPORT NEWS SHIPBUILDING**

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<b>David Samiagio</b> Avondale Industries, Inc. P.O. Box 50280 New Orleans, LA 701150-0280	SS# 045 50 7467 Citizen= USA	Tel#(504) 436-5435	Security = NA
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**ADVANCED AIR VEHICLE SYSTEMS AND  
RESEARCH ENGINEERING & TECHNOLOGY DEVELOPMENT CONTRACTS  
FINANCIAL STATUS REPORT - CUM THRU AUGUST 1996**

**D. CARTER**

G.O. 15822 Type: FP	ACT CUM THRU WK 36	CUM THRU AUG 96			Estimate To Complete		Estimate at Complete	
		Monthly Estimate	Actuals	Variance B (W)	Open Commitment: (Estimate)	Uncommitted	Budget	Sept 96 LRE
Program: Expansion of the GCRMTC Ships Reliability, Avail & Maintainability Database OPR: C. Amaral J. Willis	Lbr \$	\$28,871	\$20,657	\$8,212		\$259,032	\$325,317	\$325,317
	Other \$	\$3,329	\$1,663	\$1,668	\$0	\$54,050	\$62,083	\$62,083
	Total \$	\$32,200	\$22,320	\$9,880	\$0	\$313,082	\$387,400	\$387,400
Cont. Adr C. Price D/098-011-SJ66, X4604	Remarks: % Expended/Committed of EAC 19.2% Fully Funded The CUM underrun reflects less than anticipated labor support resulting from the initial kick-off meeting being deferred until Sep. 96. Catchback begins Aug. 96 in support of this effort.							
Period of Performance: 5-9-96 thru 5-31-97					Target Cost		\$387,400	387,400
					Target Profit/Fee		\$22,600	\$22,600
				Contract Value		\$410,000	410,000	



# **APPENDIX R**

## **ROSENBLATT SUBCONTRACT REPORT**

**University of New Orleans  
New Orleans, LA 70148**



**M. ROSENBLATT & SON, INC.**

**FIRST QUARTER PROGRESS REPORT**

**PORTFOLIO OF WORLD CLASS SHIP DESIGNS**

**COOPERATIVE AGREEMENT NO. N00014-94-2-0011**

**SUBCONTRACT #24**

**TASK ORDER 001**

**REPORT PERIOD: July 1, 1996 - October 1, 1996**

**SUBMITTED TO:**

**University of New Orleans  
Gulf Coast Region Maritime Technology Center**

**SUBMITTED BY:**

**M. Rosenblatt & Son, Inc.  
2341 Jefferson Davis Highway, Suite 500  
Arlington, Virginia, 22202-3885**



# PORTFOLIO OF WORLD CLASS SHIP DESIGNS

## FIRST QUARTER PROGRESS REPORT

July 1, 1996 - October, 1996

**PROJECT SYNOPSIS:** The objective of this project is to facilitate the development and availability of a Portfolio of World Class Ship Designs based on new and innovative technologies, new production methods, and improved facilities. The Portfolio will be made available to US shipyards in an electronic format and will include a series of standardized designs, a design synthesis model, a production program for labor and cycle time, and a master equipment list, thereby assisting the US shipbuilding industry to become competitive in the international marketplace. The Portfolio will provide the protocol needed to facilitate design evolution with manageable technical, cost, and program risk parameters.

### BUDGET STATUS:

TOTAL AMOUNT BUDGETED: \$ 365,000

FUNDS REMAINING: \$ 273,750

### ACCOMPLISHMENTS THIS PERIOD:

#### 1.0 General

The Portfolio of World Class Ship Designs project officially commenced with the kick-off meeting at UNO/GCRMTC on July 1, 1996. MR&S prepared a formal report of the kick-off meeting and copies were provided to all team members. MR&S subsequently initialized Task 1 and Task 2 as explained below. Task 3 was initialized on August 1, 1996 in accordance with the work plan. Several schedule adjustments were made in Tasks 4 through 8 as the project proceeded in an attempt to refine and improve our work plan.

Discussions were held with participating shipyards to specifically define their responsibilities, and subcontracts were issued on September 26, 1996 to Avondale Industries, Inc. and Ingalls Shipbuilding, Inc.



## **1.1 Task 1 - Market Survey and Analysis**

The MR&S team members conducted an information search in accordance with the approach outlined in the proposal [1]. A preliminary report entitled "Market Survey and Needs Analysis Report" was prepared and submitted to UNO and the participating shipyards on 19 August for review and comment. The input from the additional team members will be incorporated into a final report which will be used as the basis for selection and prioritization of the ship types for development into Baseline Designs.

The preliminary report contains a review and analysis of recent shipbuilding market studies as well as applicable shipbuilding articles and technical reports published in the maritime press. Selection criteria was established for selecting market-worthy ship designs for construction by Gulf Coast shipyards for each of the following ship types:

- a. Tanker
- b. Bulk Carrier
- c. General Cargo Ship
- d. Container Ship
- e. Roll-On/Roll-Off Ship
- f. Passenger Ship / Ferry

The existing population of various ship types was compiled from numerous sources and integrated into a common database. The database was exercised against the selection criteria to identify potential Baseline Design candidates. The results were compared with market projections and refined accordingly. Shipyard validation of our preliminary results are necessary in order to finalize the report. It is anticipated that the final report will be completed by October 30, 1996.

## **1.2 Task 2 - Production Technologies Review**

MR&S initiated this task in accordance with the proposal, however after preliminary review of the topic it was decided to extend this task throughout the project to allow for the incorporation of the latest developments in shipbuilding equipment and technologies. An information and literature search quickly revealed that considerable effort and funding has been directed to this subject, particularly by the National Shipbuilding Research Program (NSRP). The NSRP published a report in 1978, which evaluated and compared shipbuilding technologies in use by US Shipyards and foreign shipyards. A follow-on report was published in March 1995 entitled "Requirements and Assessments for Global Shipbuilding Competitiveness" [2]. The results of this most recent report will serve as guidance for discussion with foreign shipyards to identify any new technologies which should be considered. The team will prepare a quarterly report which summarizes "the best" recommendations for shipbuilding facilities and technologies which will serve as a shopping list for US shipyards. The first quarterly report will be completed by October 30, 1996, and will incorporate feedback from shipyard team members.



### **Task 3 - Design Synthesis Model**

Design synthesis models have been identified as one of the most effective tools to facilitate design evolution to suit customer needs. Together with selected baseline designs, US shipyards can utilize design synthesis models to respond quickly and confidently to client inquiries. The architecture of commercial design synthesis models varies with ship type, such as container ship, bulk carrier, or tanker. The MR&S team selected a chemical tanker as the candidate ship for development of the first synthesis model. A chemical tanker was selected as the most sophisticated of the tank ships so as to incorporate as many design functions into the model as possible.

The synthesis model is being designed to be as user shipyard friendly as possible, consistent with readily available and commonly used hardware and software and an interactive Graphical User Interface (GUI) utilizing on-screen forms. This program is being developed for an IBM PC compatible computer. The target computer has a Pentium processor equipped with 16 megabytes of RAM running Windows 3.1. The program is being developed using Visual Basic 4.0, Fortran, and the Microsoft Access 2.0 database.

The Synthesis Model task is well under way. The 1st quarter effort has been focused on developing the functional design architecture. The overall architecture of the Ship Synthesis Model has three parts: computational modules, interactive forms, and database.

**Computational Modules.** The computational modules are used to synthesis the ship once the user has defined the ship parameters. The design of the synthesis loop has been completed with the exception of weight estimating parameters. This design includes hull form definition, subdivision, tank configuration, powering predictions, engine selection, loading conditions, and stability analysis. Initial coding has been completed for powering (utilizing the Holtrop and Mennen method), hull form definition, tank definition, and tank volume and centers calculations.

**Interactive Forms.** The basic architecture of these forms is under development. These forms will be used to input the master equipment list, define the ship parameters, and to review and print the results.

**Database.** The preliminary database design has been completed. An initial Microsoft Access database has been developed and is being populated with data as the computational modules and interactive forms are being developed. This database will be expanded as additional portions of the code are developed. The database will be completed when all of the code modules are completed.



#### Task 4 - Selection of Ship Types

The selection of six ship types and establishing their priorities for further development is being conducted under Task 1, Market Survey and Needs Analysis. Preliminary results indicate that the first priority Baseline ship is a Chemical Tanker with the following characteristics.

Principal Characteristics of Baseline Chemical Tanker			
LBP, m	150.0	Depth, m	13.1
Beam, m	24.7	Draft, m	9.6
DWT, mt	21,500	Speed, kts	14.3
BHP	8,300		

The documentation supporting the final selection and prioritization of ship types will be completed by October 30, 1996.

#### Task 5 - Concept Studies

In order to maximize the commonality for producibility, it was necessary to investigate other ship types. MR&S reviewed the Fairplay Shipping Database to confirm/establish the principal characteristics of the Portfolio series, with particular attention to the chemical/products tanker and the containership, since it is believed these two will drive the others. The search was limited to vessels built after 1980, between 135m and 185m LOA. Records containing zero values in any of the fields were eliminated. The search identified approximately 480 containerships and 750 chemical and products tankers.

Particulars investigated were beam, depth, draft, DWT, speed, engine total HP, and TEU in the case of the containerships. These were plotted against LBP, and trend lines were established using either linear or power fits, as appropriate. The results of this database review are presented in Table 1 below, for the design LBP of 150m.

**TABLE 1: Fairplay World Ship Population Study**

Ship Type	LBP	Beam	Depth	Draft	DWT	Speed	BHP
Container	150.0	25.0	13.1	9.2	17,200	17.7	12,500
Chemical Tanker	150.0	24.7	13.1	9.6	21,500	14.3	8,300

To determine the feasibility of using the same hull form for all ship types, the characteristics of the containership and the chemical tanker were further refined utilizing data from several other sources, i.e., PNA, Watson & Gilfillan, design notes, etc. To address the speed and displacement differences, the drafts were adjusted to accommodate the common hull form. It is assumed at this point that the bulbous bow and the stern configuration would be optimized for the containership drafts and speed, since this variant will have the higher power requirement. Powering was



established using the method developed from the Holtrop-Mennen regression analysis. The refined characteristics for the containership and the chemical tanker are presented in Table 2 below.

The dimensions of the containership will drive those of the other vessel types due to the modular size of its cargo. The beam of 24.75m was chosen to accommodate deck cargo for 10 containers across, along with 8 across in the holds allowing for standard spacing of the cell guides and wing walls of 2.333m. The aft container bays in Holds 1 and 3 were sized to accommodate 45 foot containers, which is consistent with operators desire to have 20% of the below deck space for these oversized containers. With the hold sizes in mind, it was found that frame spacing of 770mm would allow web frames spaced at four frames, with an extra web in the center of the 45 foot bays, to accommodate 20 foot containers, and hatch side box girders 1½ frames wide. These dimensions are reflected in the latest sketches for the containership and the chemical tanker.



**TABLE 2: SHIP DESIGN SERIES PORTFOLIO**

1.667 m D.B. height, 2.333 m wing wall, 8 containers across x 5 high, 1.65 m coaming height  
 Tanker wing wall: 1.667 m

Ship Type	LBP	Beam	Depth	Draft	B/T	DWT	Speed	Fn	Lightship	Displ.	C <sub>b</sub>	C <sub>m</sub>	C <sub>p</sub>	C <sub>wp</sub>	C <sub>vp</sub>
Container	150.0	24.75	13.0	8.8	2.81	16,600	17.6	0.234	7270	23,870	0.711	0.986	0.721		
Chemical Tanker	150.0	24.75	13.0	10.2	2.43	21,300	14.7	0.195	7016	28,316	0.730	0.988	0.738	0.817	0.893

Ship Type	E	K	W <sub>s7</sub>	Weights		W <sub>M</sub>	LS <sub>Calc.</sub>	Powering	
				W <sub>s</sub>	W <sub>O</sub>			SHPCW	Installed BHP
Container	6404	0.034	5108	5036	1195	900	7274	13,210	16,879
Chemical Tanker	6228	0.037	5352	5268	1051	560	7016	8,330	10,644



### **Task 7 Master Equipment List (MEL)**

A preliminary Master Equipment List was developed. This included a ship equipment catalog for prime movers, electrical generators, and other major components. The basic structure of this catalog represents equipment available to the ship designer. Once this data is entered into the MEL, it can be selected for inclusion in a particular design via the Ship Synthesis Model. Database links will be developed that integrate the MEL catalog with selections made for a given design. The Master Equipment List will contain various information including manufacturer, equipment type, size, weight, cost and other design and manufacturing specific data as specified by the shipyards.

The MEL will contain definitions of propulsion engine series including series name, description, configuration (in line or vee), bore, stroke, manufacturer, KW/cylinder, RPM, SFC, and KG from equipment baseline. Each series will be comprised of a number of individual engines including the number of cylinders, weight, cost, length, and man-hours required for installation. A similar architecture has been developed for generator sets including diesel and shaft-driven generators.

An Access database comprised of 7 tables and 50 data fields was created. This database was populated with sample engine manufacturer data for propulsion engines and electrical generators.

### **Task 8 - Production Model Data (SBD)**

It has been agreed that the UNO/GCRMTC Simulation Based Design Center will provide focused support to this task. The SBD resources will be used in parallel with the development of the synthesis models and Baseline Point Designs to visualize and validate the development process. Based on the selected characteristics of the first Baseline Ship, the UNO/GCRMTC will develop a 3D parametric surface model based on similar existing ships. As the general arrangements (tank configurations, accommodations, etc.) are determined the internal details of the model will be developed. As the Baseline Point Design develops, the ship structure can also be developed and visualized based on the Midship section scantlings. The final step in the development of the SBD model will incorporate the distributive systems (piping, electrical and HVAC) into the hull and superstructure.

The synthesis model and the point design can be refined through the use of the SBD model and the SBD model can be updated to reflect the latest status of the design. The final SBD model will be a useful tool for the shipyards to use in developing their build strategy and product model definition.



## **PROPOSED ACTIVITIES NEXT PERIOD:**

**Task 2 - Production Technologies.** Continue search for new technologies and conduct shipyard review.

**Task 3 - Synthesis Model.** Continue development and testing of computation modules. Develop algorithms to estimate weights and centers. Develop user interface design. Continue to develop the database structure and populate with test and the Baseline Point Design as information becomes available.

**Task 6 - Baseline Point Design (First Ship Type).** Commence definition of first Baseline Point Design.

**Task 7 - Master Equipment List.** Continue development of MEL to suit the requirements of the Synthesis Model and Baseline Point Design. Incorporate results of shipyard review and information.

**Task 8 - Production Model Development (SBD).** Establish protocol for exchange of information with UNO/GCRMTC for SBD model. Begin model development.



**COLLABORATIVE EFFORTS:**

	This QTR	YTD
DOLLAR VALUE OF SERVICES FROM INDUSTRY		
IN KIND SERVICES	n/a	n/a
ACTUAL FUNDS	n/a	n/a
DOLLAR VALUE OF SERVICES FROM GOVERNMENT		
IN KIND SERVICES	n/a	n/a
ACTUAL FUNDS	n/a	n/a
NUMBER OF SIGNIFICANT CONTACTS		
INDUSTRY:	n/a	n/a
ACADEMIC:	n/a	n/a
GOVERNMENT:	n/a	n/a

**COMMENTS:**

The task is generally proceeding in accordance with the planned work schedule and it is anticipated that the stated goals and deliverables will be achieved on schedule and within the allotted budget.

**REFERENCES:**

1. "Proposal for the Development of a Portfolio of Ship Designs," RFP 5676, M. Rosenblatt & Son, Inc., 15 September 1995.
2. "Requirements and Assessments for Global Shipbuilding Competitiveness", NSRP Report, Ship Production Committee, Design/Production Integration Panel (SP-4), Richard Lee Storch, A&P Appledore International LTD, and Thomas Lamb, March 1995.

**ENCLOSURES:**

Enclosure 1: First Quarter Meeting Agenda

Enclosure 2: First Quarter Meeting View Graphs



**First Year Work Schedule for a Portfolio of  
World Class Ship Designs**

No.	Task Name	1996												1997											
		J	A	S	O	N	D	J	F	M	A	M	J	J	J	J	J	J	J	J	J	J	J	J	J
	Kick-off Meeting	7/1																							
1.	Market Survey and Analysis																								
2.	Facilities and Production Technologies Review																								
3.	Design Synthesis Model																								
	Architecture																								
	Database																								
	Cost Modeling																								
	Validation and Verification																								
4.	Selection of Ship Types for Development																								
5.	Concept Studies																								
6.	Develop Point Designs																								
	Design No. 1																								
	Design No. 2 (Start Year 2)																								
	Design No. 3 (Start Year 2)																								
	Design No. 4 (Start Year 2)																								
7.	Obtain Product Model Data (MEL)																								
8.	Production Model Support (SBD)																								
	Surface Model																								
	Internal Arrangements																								
	Structures & Systems																								
	Benchmark the Production Program (Start Year 2)																								
10.	Implementation Plan																								
	Quarterly Report and Review (1st and 2nd)																								
	Quarterly Report and Review (3rd and 4th)																								



# **APPENDIX S**

## **CYBO-ROBOTS SUBCONTRACT REPORT**

**University of New Orleans  
New Orleans, LA 70148**



**Cybo Robots Inc.  
Quarterly Status Report  
July, Aug, Sept, 1996**

**Submitted to University of New Orleans  
Office of Research and Sponsored Programs  
Agreement # N00014-94-2-0011  
Subcontract #23**



Due to staffing considerations and exchange of confidentially agreements between the participating companies and late receipt of formal contract agreement this project has been two months late in getting started. It is the intention of both participating companies to make up some of this lost time and complete on schedule.

On August 2, 1996 Cybo Robots and N-A-Technologies meet to discuss specific requirements of the project. Initial use of the neural net processing shall be in line with the panel type welding that has been selected for demonstration under Cybo Robots ARPA project, Portable Shipbuilding Robotics. Currently Cybo's Off-Line Programming system facilities manual or external ship design database entry of the weld specification for each weld segment. This entry is designed in the form of a neural file script format specifically to transfer weld specification information. Specification in this format refers to the size and type weld, not the specific process. For example a 7mm fillet with 90 degree included angle with a maximum allowed gap of 4 mm. would be specified as {fillet, 7,7,4, 90}. As we know the process parameters will vary for the same weld specification based on build factors such as surface preparation and position of the weld. The off-line planner has the ability to determine many of these factors automatically, such as position of the weld. Other factors are known from the design database of manufacturing methods standpoint, such as surface preparation. The off-line programming will be modified to automatically extract or determine the key factors. The key factors will then act as input parameters to the neural-net processing which will return a set of process boundary parameters that will be used by the robot controller. The controller will use these boundary conditions in conjunction with its associated sensor strategies to automatically execute its adaptive process control. At this point in time selection of the weld process (process and associated boundary conditions) which can produce the specified weld is a manual operation within the OLP.

The adaptive process boundary variables will consist of the following process variables:

- Minimum and maximum wire feed speed (estimated between 200 to 450 ipm)
- Minimum and maximum voltage at corresponding wire feed rates (estimated between 22 to 26 volts)
- Minimum and maximum travel velocities (estimated to be between 5 to 15 ipm.).
- Travel angle (estimated between 10 degree push to 10 degree drag) depending on weld position.

The independent variables that the neural net will be trained around have been specified as:

- Gap (0-4mm)
- direction [V-U (Vertical-up), OH (overhead), H (horizontal), F (Flat)]
- desired fillet size - output parameter
- Material thickness ???

The following process variables have been determined to be fixed



## *Cybo Robots*

- Filler material / consumables:
- CTWD (0.750")
- Current (varies)
- Wire Diameter (0.045" )
- Gas Type and Flow Rate (100% CO2, 40-45 CFH)
- Power Supply (CV, Hobart Arc Master 501 or Excel Arc)
- Voltage @ the torch (22-26)
- Wire process FCAW
- ESAB Dual-Shield II Ultra (E71-T1)

### Material:

- Type (AH-DH 36)
- Primer type
- Thickness (0.250 - 0.625)

### Weaving characteristics:

- frequency fixed
- amplitude fixed



## Neural net training experiments

The following variables have been identified as key parameters to the weld process for the identified application. They include position of the weld, condition of the fillet fit-up and corresponding process parameters (wire feed rate, voltage, travel angle, travel speed). A series of welded examples based on these variables will be used to form the bases of training the neural net.

Fillet Gap	0	2	3	4 (mm)		
Position	F	H	H-V	V	OH-V	OH
Lead/Lag $\Delta$	-10	0	+10	(degrees)		
V	-10	0		(degrees)		
H		0	+10	(degrees)		
H-V		0		(degrees)		
OH-V		0		(degrees)		
CTWD	0.625	0.750	0.875	1.000	(electrical stick-out, in.)	
Wire Feed Rate	150	230	310	400	(in/min)	
Travel Speed	4	8	12	15	(in/min)	
Voltage	22	24	26	28	(volts)	
Out of Pos.	22	24	26		(volts)	
H and F		24	26	28	(volts)	
Thickness	0.250	0.375	0.500	0.625	(in.)	

### Fixed Variables

Weave Freq.  
 Weave Amplitude.  
 Primer (paint)  
 Material Type  
 Gas Type  
 Gas Flow Rate  
 Wire Type  
 Wire Diameter  
 Power Supply

N-A-Technologies has investigated the total combinations of samples (tests) that must be run to properly train the net. A optimizing technique developed by N-A-Tech will is currently being utilized to intelligently reduce the number of weld tests that must be run.



## *Cybo Robots*

### **Software communication**

Time was spent investigating method of interfacing the neural net processing software with Cybo's Off-Line programming system. It has been determined that packages will communicate TCP/IP sockets.



**S-7**

Schedule	TASKS:																																															
	July				August				Sept				Oct				Nov				Dec				January				February				March				April				May				June			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Duration																																																
1. Define Requirements	1.06 mo																																															
2. Define Learning Experiments	1.06 mo																																															
3. Develop Test Samples	0.97 mo																																															
4. Weld Samples	1.98 mo																																															
5. Develop the Neural-Net based on Determined Parameters	2.94 mo																																															
6. Develop Software Interface	1.06 mo																																															
7. Develop Operator/System Interfaces	2.90 mo																																															
8. Experiment Analysis	1.93 mo																																															
9. Integrate Neural-Net Algorithm with AOLP	1.89 mo																																															
10. Refine Model Support	2.02 mo																																															
11. Documentation & Report	0.97 mo																																															